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Front cover: *Caladenia hastata*. Noushka Reiter watering plants after translocation. Photo: Gail Pollard

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Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. General articles on any plant conservation issue are most welcome.

The deadline for the **June – August 2018 issue is 11 May 2018**. The special theme for the issue is **Translocation of threatened plants – Part 2**. If you are intending to submit an article or wish to discuss possibilities, please email the editor, Heidi Zimmer: editor@anpc.asn.au

Authors are encouraged to submit images with articles or information. Please submit images in electronic format, resolution needs to be at least 300 dpi, at least the size that they are to be published, in tif, jpg or gif format. Guidelines for authors and an article template are at: **http://www.anpc.asn.au/apc**.

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The production of this edition of *Australasian Plant Conservation* was supported by the **NSW Environmental Trust** through its Lead Environmental Community Groups program.

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From the editor

HEIDI ZIMMER

This issue is the first of several issues of *Australasian Plant Conservation* focusing on threatened plant translocation to mark the coming of the Third Edition of the ANPC's 'Guidelines for the Translocation of Threatened Plants in Australia', due in mid-2018. Experts from across Australia are contributing to this new edition of the Guidelines, led by Lucy Commander, and funded by the National Environmental Science Program's Threatened Species Recovery Hub.

We begin this issue in Western Australia, where Leonie Monks *et al.* describe translocation of Spiral Fruited Wattle in Western Australia, in a project now spanning 20 years, with the first plantings undertaken in 1998. Next we move to South Australia, where Doug Bickerton and others present a translocation case study focusing on Spiny Daisy. They share insights on the challenges of monitoring a plant that primarily (or only) spreads vegetatively, and the variable survival of different clones used in translocation. After this we move further east, to Victoria, where Noushka Reiter and others discuss the challenges of pollinator limitation in establishing populations of Melbloms Spider-orchid. Nevertheless, they record an average survival rate of 83%, with flowering and seed set on track to meet long-term goals.

We head west again, for the establishment of *Ricinocarpos brevis* populations in Western Australia on waste rock landforms associated with mining. Like many of the translocation case studies, Carole Elliott *et al.* highlight the importance of research in refining translocation methods to achieve the best outcomes. Next, Manfred Jusaitis tells the story of the translocation of the Monarto mintbush in South Australia. This is another example of a translocation project with valuable long-term data – initial plantings occurred in 1995. This is a particularly interesting story in that it demonstrates the value of protecting plants from grazing (leading to increased growth and reproduction) but, on the other hand, shows increased drought mortality in plants protected from grazing – highlighting the complexities involved in translocation management.

Next we head to New South Wales, where Nathan Emery and others describe the translocation of the North Rothbury Persoonia, emphasising the value of using an experimental framework. They too found varying effects of fencing; while protecting from macropods, fencing also increased competition from other plants. They also compared seedling and cutting-grown plants, finding higher survival rates in the former. For the last translocation case study we head to Tasmania, where Phil Collier and Robin Garnett emphasise the value of smaller translocations, with the Wrinkled Dollybush – known only from two private properties. They show the importance of protection from grazing, especially post-fire, when these valuable plants were the dominant 'green pick' at the site.

In our regular features we have a report on the Seed Conservation Techniques Training that was conducted in New Zealand late last year by the Australian Seed Bank Partnership and a member profile introducing APC's incoming editor (me!). The book reviews are on the Fungi of Australia: Incocybaceae ('little brown mushrooms'), and on Rocky Outcrops of Australia. We finish with news and research from around Australia and the world. Enjoy!

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Threatened plant translocation case study:

Acacia cochlocarpa subsp. *cochlocarpa* (Spiral Fruited Wattle), Fabaceae

LEONIE MONKS*, DAVE COATES AND REBECCA DILLON
Department of Biodiversity, Conservation and Attractions, Western Australia
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The Species

- Prostrate long-lived shrub.
- Endemic to Western Australia.
- Five extant natural populations that occur over a 300 km range to the north and east of Perth.

Threatening Processes

- Habitat loss and significant habitat fragmentation through agricultural development.
- Weed competition.
- Herbicide spray drift.
- Risk of accidental destruction during maintenance of the road verges.

Deciding to translocate

In 1997 *Acacia cochlocarpa* subsp. *cochlocarpa* was known from just two small populations confined to a narrow linear remnant along a road verge with a combined total of 51 plants. As a result of its rarity and the ongoing threats, *A. cochlocarpa* subsp. *cochlocarpa* was listed as Rare Flora in 1997 under the Western Australia *Wildlife Conservation Act 1950* and ranked as Critically Endangered. Subsequently an Interim Recovery Plan was developed to oversee the recovery process. Despite the discovery of three new populations more recently, a combination of the small number of populations, extremely limited available habitat and threats that were difficult to manage effectively *in-situ* meant that the species was always likely to continue to decline without significant management intervention. The establishment of a translocated population in a new secure location was considered to be the most effective action to initiate successful recovery of the species.

Aim of the translocation

The aim of the translocation was to successfully establish 200 mature adult plants in a secure site where threats were absent or could be effectively managed. We aimed to establish a viable population, one that was capable of undergoing natural population processes, such as producing viable seed and recruitment of subsequent generations.

Golden flowers of the Spiral fruited wattle.
Photo: L. Monks/DBCA

Translocation working group and key stakeholders

- Department of Biodiversity, Conservation and Attractions, Western Australia (formerly Department of Conservation and Land Management) – to oversee development and implementation of translocation and ongoing monitoring and maintenance of translocation sites.
- Department of Biodiversity, Conservation and Attractions, Western Australia (Botanic Gardens and Parks Authority) – propagation of seedlings.
- Moora District Threatened Flora Recovery Team – to oversee implementation of Interim Recovery Plan for the species, including translocation.

Biology and Ecology

- Insect pollinated.
- Seeds are gravity dispersed and can also be dispersed by ants.
- Seeds are physically dormant.

- Dormancy is broken when the seed coat is breached, often by fire, so recruitment is primarily confined to post-fire period (Yates and Broadhurst 2002).
- The subspecies is known from areas of red to brown clay within open low scrubland.
- Climate is Mediterranean with hot dry summers and cool wet winters.

Site selection

Site selection initially involved overlaying vegetation maps and geological maps and highlighting areas that contained similar vegetation associations and underlying geology as that found at the remaining locations of this species. Site visits were made to the areas that had similar vegetation and geology, particularly those sites that occurred on conservation estate. Plant species that occurred at the potential site were identified, soil type was described and any threats that occurred or could potentially occur in the future were noted.

Initially, two sites were chosen in a nature reserve that was less than 5 km from the natural populations, as these sites had the same soil type and vegetation type as the natural populations and many associated plant species in common. A further two sites were chosen in another nature reserve, also with similar habitat features, a decade after the first two sites had been established.

Translocation proposal

A Translocation Proposal was developed using a template provided by the (then) Department of Conservation and Land Management (CALM) to guide and provide justification for the translocation. The Proposal was submitted to CALM where it was assessed by two independent reviewers as to whether it met the Department's policy on plant translocations (Anon 1995), before being given approval for the translocation process to commence.

Pre-translocation preparation, design, implementation and ongoing maintenance

Both sites were areas where gravel extraction had previously occurred. In preparation for the translocation both were deep ripped to alleviate the compaction from the former use of these sites.

The first planting, in 1998, utilised direct seeding, where seeds were pre-soaked in boiling water prior to translocation planting in an attempt to break physical dormancy. Seeds were planted in one of five small fenced areas (16 m x 5 m) to protect any germinants from grazing by vertebrate herbivores. Initial germination was poor (just 4%) and prompted a move to use nursery-propagated seedlings in subsequent plantings. An experimental design to assess whether summer watering, mulch or a combination of water and mulch would enhance survival and growth of germinants was set up, but due to the poor germination, results were not able to be analysed.

Experiments designed to assess translocation methods were undertaken in 1999 and 2000. These investigated seedling age at planting, summer watering, and grazing. The impact of grazing was assessed by planting seedlings within or outside five small fenced areas which excluded kangaroos and rabbits. The influence of summer watering was assessed by applying one litre once a week (delivered by an automated gravity fed system) to half the plants. The effect of plant age at planting was assessed by planting seedlings that had either been grown for one year or two years in the nursery.

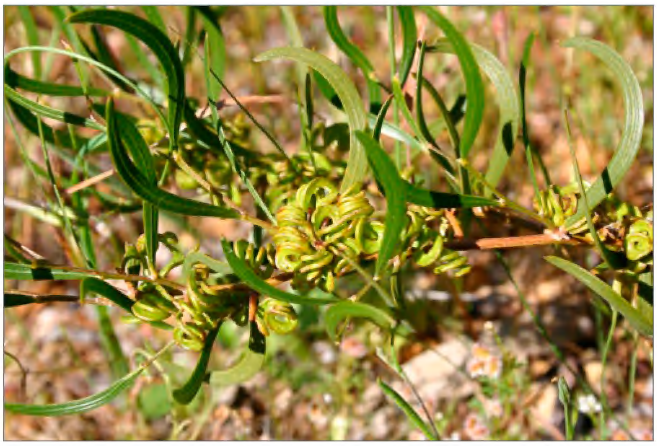
Monitoring and evaluation

We monitored plant survival, growth (plant height and width), health, flowering and fruiting. By 2009, annual monitoring had shown the two sites doing well, with survival at 40% (214 plants) at the first site and 70% (318 plants) at the second site. All plants had flowered and set viable seed. In both cases the numbers of adult plants at the translocation sites had exceeded our goal of 200 adult plants.

Monitoring enabled evaluation of the effectiveness of the grazing, watering and plant age treatments. Results, ten years after planting, indicated that by excluding herbivores almost twice as many plants survived (55% of fenced plants compared to 29% of unfenced plants),

Implementing a prescribed fire on a translocated population of the Spiral fruited wattle to induce recruitment. Photo: L. Monks/DBCA

Infill planting at a translocation site for the Spiral fruited wattle. Photo: L. Monks/DBCA



The characteristic seed pods of the Spiral fruited wattle. Photo: L. Monks/DBCA

slightly more plants watered over the first summer survived (81% compared to 76%) and marginally more one year old seedlings survived than the older two year old seedlings (80% compared to 76%).

Subsequent actions

Based on the ten years of monitoring data from the first translocations the decision was made to establish additional populations in other locations to ensure the long term viability of the species. Two new sites were chosen in another nearby reserve and planted with seedlings in 2010 and 2017. Using the knowledge gained from the first two translocations the sites were both fenced and all seedlings were watered over the initial establishment period, during the summer months.

Whilst the monitoring data showed good survival, and flowering and fruiting occurring at rates similar to the natural population, there had been no recruitment. For the translocations to be considered successful the population must be able to recruit subsequent generations. This lack of recruitment was not unexpected as previous research had indicated that recruitment was largely confined to a post-fire period (Yates and Broadhurst 2002). However, in the fragmented, highly cleared landscape in which the translocation sites are located, fires are unlikely. So the decision was made to carry out a management burn at the original translocation site to encourage recruitment. The population of 183 adult plants was burnt in 2015 and follow up monitoring showed significant recruitment from the seed bank (>900 seedlings) and some survival and resprouting of a small number of adult plants. Seedling survival two years after the burn, was close to 80% and a small proportion of plants (25%) had become reproductive.

This research will be incorporated into a Population Viability Model that is being developed for the species. The model will aid decisions relating to long term population viability such as how many plants are required per population, how many populations will ensure species persistence and what is the appropriate fire regime.

Outcomes

The original aim, which was to establish 200 adult plants, was met and exceeded with the establishment of four new viable populations of greater than 200 adult plants each, in secure, threat free sites.

What we learned

- It is possible to establish new populations of this species.
- Using an experimental framework when establishing translocations can provide critical information for long term translocation success.
- Fencing and summer watering improves survival of planted seedlings.
- Younger (1 year old) seedlings established better than older (2 year old) seedlings.
- Controlled burn of an adult population, which had set seed, stimulated recruitment.

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Threatened plant translocation case study:

Acanthocladium dockeri (Spiny Daisy), Compositae

DOUG BICKERTON[1*], TIM FIELD[2], CHRISTOPHE TOURENQ[2] AND KYLIE MORITZ[1]

[1]Department of Environment, Water and Natural Resources (SA)
[2]Banrock Station, Accolade Wines
*Email: Doug.Bickerton@sa.gov.au

The Species

- Small upright spreading shrub.
- Clonal.
- Six extant natural populations within a 110 km range in South Australia's mid-North region.

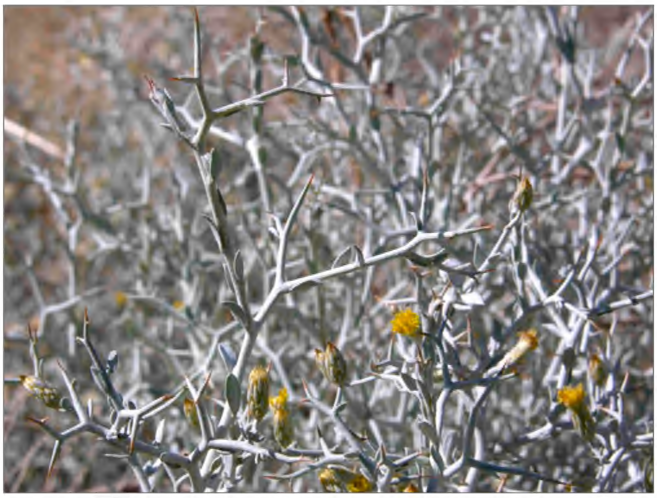

Figure 1. *Acanthocladium dockeri* leaves, flowers and spines. Photo: E. Rees

Threatening Processes

- Weed competition.
- Low genetic diversity.
- Road and roadside maintenance.
- Herbivores – exotic snails, rabbits, hares, kangaroos.
- Agricultural chemical drift.

Deciding to translocate

Twenty years ago, *Acanthocladium dockeri* was known from only two historic records: Menindee Lakes, NSW (1860), and Overland Corner, Murray River, SA (1910). After failed attempts in the 1990s to locate the species, it was considered to be extinct, until a population was discovered in 1999 near Laura (SA), 210 km NW of Overland Corner.

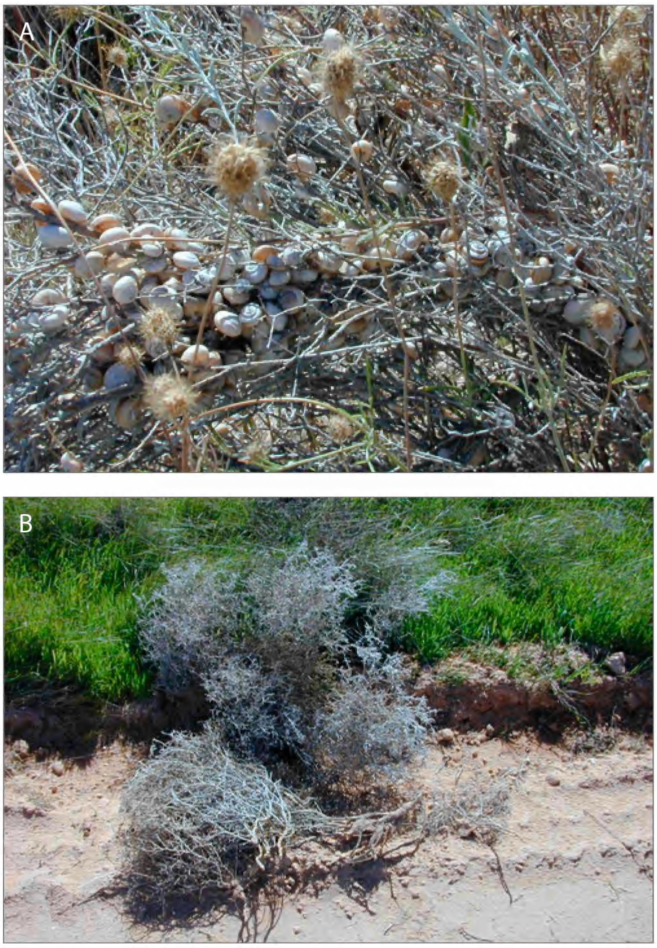

Figure 2a. Exotic snails on an *Acanthocladium dockeri* stem; 2b. Grader damage. Photos: M. Jusaitis

Another five populations were subsequently discovered, within 70km of Laura, all on roadsides and adjacent agricultural land. Most were in degraded, weedy habitats. Given the limited area of occupancy, fragmented habitat and inferred decline, the species was listed as Critically Endangered under the *EPBC Act*.

All populations are clonal, reproducing vegetatively. Seed viability is very low, and propagation attempts using seed have failed. Given the difficulty and effort in managing threats at the remnant sites, translocations were attempted between 2000-2010, within its extant range,

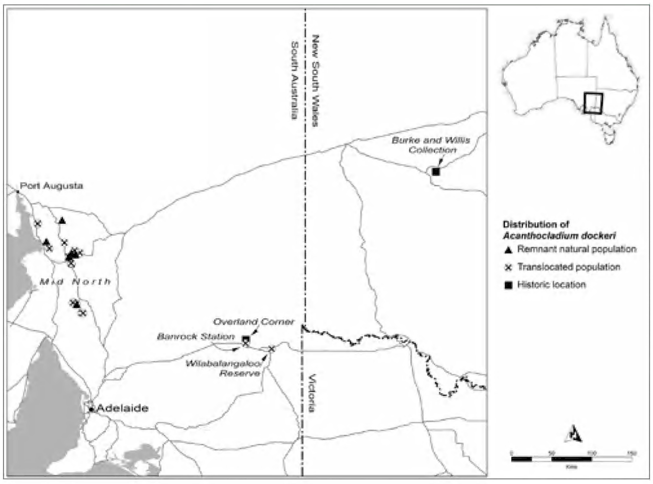

Figure 3. ***Acanthocladium dockeri*** **distribution.**

as either augmentations of remnant populations, new back-up populations or education sites. These met with mixed results due to soil type, aspect, snails, follow-up maintenance or rainfall.

Despite these translocations, the number of populations and extent of occurrence remained small; many sites were without secure tenure and threatened by disturbance, especially remnant sites. In 2013 the Recovery Team decided to search for suitable translocation sites in the vicinity of Overland Corner.

Aim of the translocation

- Establish three self-sustaining subpopulations of mixed genotype *A. dockeri*.
- Increase the species' extent of occurrence.
- Engage the community in the translocation process and increase awareness of the Spiny Daisy Recovery Project through partnership with Banrock Station.

Translocation working group and key stakeholders

- Spiny Daisy Recovery Team.
- Accolade Wines (Banrock Station).
- Trees For Life Inc.
- Natural Resources South Australian Murray Darling Basin (NR SAMDB).
- Natural Resources Northern and Yorke.
- Department of Environment, Water and Natural Resources (DEWNR).

Biology and Ecology

- Seed production and seed viability are very low.
- Appears to only spread vegetatively, by root suckers.
- All natural populations are clonal, but each is genetically distinct.
- Re-establishes quickly after fire.
- Variable soils – sandy to sandy loam, but also clay loam.
- 220 – 450 mm annual rainfall.
- Remnant grasslands or low shrub-lands on low hills and plains. Historically from low sand hills on river flood plains.

Site selection

Department of Environment, Water and Natural Resources (DEWNR) and Natural Resources SA Murray-Darling Basin (NR SAMDB) ecologists surveyed the area for sites with suitable soils and rainfall, minimal threats and security of tenure. Banrock Station was selected for its secure tenure (i.e., a Ramsar Wetland), management with a proven commitment to conservation, and capacity to manage the sites long-term. The threats are absent or minimal and easily managed. The habitat is healthy, stable and similar to that of Overland Corner (only 4 km away). Two ecologists are employed full-time to manage the wetland, with a nursery for propagation and available water for seedling establishment.

Three sites of suitable habitat were chosen on land with gentle slopes and minimal public access.

Translocation proposal

A Translocation Proposal was written in accordance with ANPC Guidelines (Vallee *et al.* 2004), and approved by the Spiny Daisy Recovery Team. A Memorandum of Understanding was agreed upon by Accolade Wines and DEWNR, to cover the translocation project and the on-going support and maintenance.

Pre-translocation preparation

In total, 1759 cuttings were collected from the six remnant populations in spring 2013, and propagated at the Banrock Station nursery. Cuttings were dipped in rooting hormone and potted into trays with a mix of peat moss, vermiculite and pearlite. When cuttings were large enough they were transferred to 90 mm tubes to develop larger root systems. By winter 2014, 940 individuals had been propagated, of which about 800 were suitable for planting out.

One week prior to planting, the translocation sites were rotary-hoed to 20 cm depth. This tillage destroyed the major weeds e.g., onion weed (*Asphodelus fistulosus*), and no other immediate weed control was necessary.

Design and implementation

The plan was to plant 30 individuals sourced from each of the six remnant populations, at each translocation site (90 plants/clone; 540 plants total). However, insufficient plants were available from two clones at the time of planting. Consequently, 396 individuals were planted in July 2014, comprising 90 each from four clones and 36 from a fifth.

Individuals were planted 50 cm apart, in rows 1 – 1.5 m apart. Each clone was planted as a group, and native species were planted between the clone groupings. Rows were named and tagged. Plants were watered by dripper lines, each site supplied with a polytank and timer. Corflute guards were placed around the plants, and a rabbit-proof fence was constructed around each site.

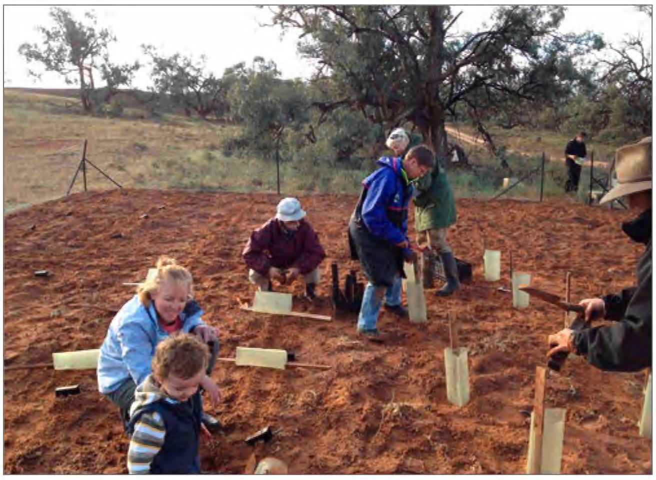

Figure 4. Planting *Acanthocladium dockeri*, June 2014. Photo: C. Tourenq

Ongoing maintenance

The plants were watered after planting, then thrice weekly in the first summer. Weeds were controlled using minimal disturbance techniques. Baiting was used to control introduced snails as required. Guards were removed when they started restricting plant growth.

Subsequent actions

In spring 2015, additional cuttings were collected from the fifth and sixth populations for propagation. This enabled a second planting in July 2016 of 39 and 37 plants respectively, dispersed evenly across the three sites. A further trial in a flood-prone site with more clay content on the wetland margins was attempted but failed.

Growth, survivorship and establishment were monitored quarterly in year 1, biannually in years 2-3, and annually thereafter, recording:

- Survival of translocated individuals.
- Number of ramets per individual.
- Growth of plants and ramets as per Clarke and Haase (2012) i.e., height, width and perpendicular width.
- Presence and abundance of flowers and fruits.

The monitoring methods will change in 2018 as it becomes increasingly difficult to determine each new ramet's source plant. The new method will measure percentage coverage of *Acanthocladium dockeri* within a 1 m^2 quadrat placed around each original plant.

Outcomes

- The survival rate was 94.4% (year 1), 89.1% (year 2) and 87.2% (year 3).
- The best survivorship (93.3%) and the most prolific ramet production at all sites was displayed by Melrose clone plants.
- The 'Native Jasmine' site has had the best survivorship across all genotypes (86%), and the plants at this site have produced the most ramets (1,859).
- The least successful plants were sourced from Yangya.
- No flowers have produced a viable fruit.
- This summary of outcomes was provided by T. Field (pers. comm., February 2018).

What we learnt

- *Acanthocladium dockeri* benefits greatly from soil disturbance. Soil tillage prior to planting allowed plants to thrive and spread more quickly.
- Regular watering through the first summer greatly improved plant survivorship.
- The extra attention provided by the on-site ecologists was invaluable.
- *Acanthocladium dockeri* survives in clay soils, but prefers open sandier soils.

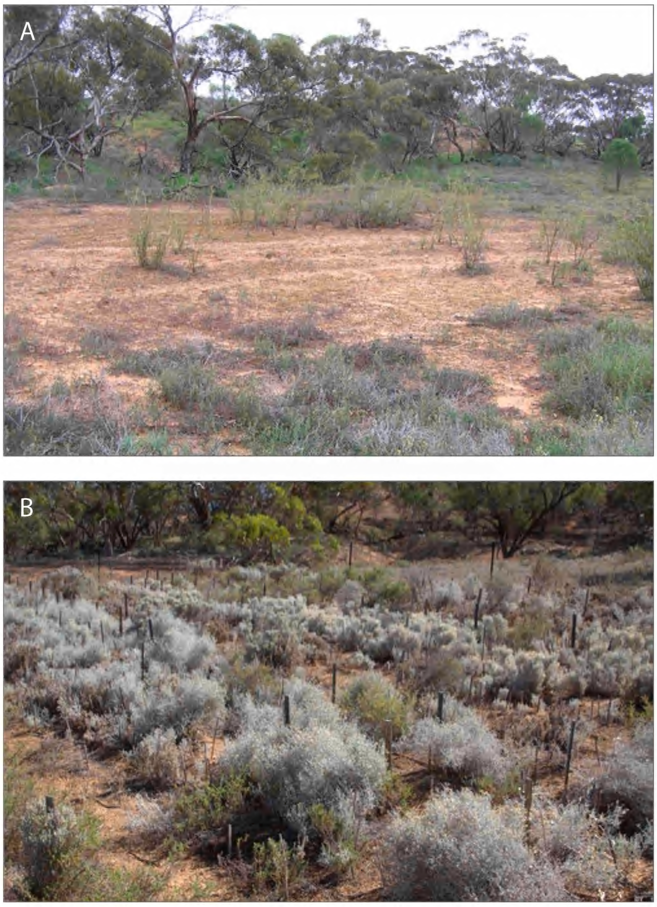

Figure 5. Banrock's Native Jasmine site before and after; a) June 2014, b) February 2018. Photos: D. Bickerton and T. Field

- Kangaroos browse ramets, but less so older plants. Their impact is substantially less than that of rabbits or snails.
- The prospect of a good conservation story attracted a corporate partner, ensuring media attention and improving community engagement.

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Threatened plant translocation case study:

Caladenia hastata (Nicholls) Rupp (Melbloms Spider-orchid), Orchidaceae: Pollinator rarity limits conservation translocation sites in a rare orchid

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The Species

Caladenia (Figure 1) is a diverse genus, with over 350 species recognised in Australia (Phillips *et al.* 2009). *Caladenia* are deciduous terrestrial orchids that die back annually to small, spherical subterranean tubers that are protected by a tough, fibrous tunic. *Caladenia hastata* (Melbloms Spider-orchid) has a single green, linear-lanceolate, sheathing, basal leaf, which is approximately 15 cm long, 10 mm wide and conspicuously hairy (Todd 1999). Plants flower for approximately four weeks each year between late September and late November. Flowering scapes grow to 30 cm in height, bearing one or rarely two, cream-coloured flowers approximately 80 mm in width. The petals are 25- 45 mm in length with dark red osmophores that exhibit a characteristic club-like swelling. The labellum has a strongly recurved apex.

Previously widespread across western Victoria and adjacent parts of South Australia (Hill *et al.* 1999), *C. hastata* is currently known from only five small populations (four natural and one failed relocation) and is highly vulnerable to extinction from a range of threats. The current number of known mature individuals is only 379, with the majority of these individuals occurring at only two populations. The remaining three populations support only one or two individuals. *Caladenia hastata* is listed as:

- Endangered under the DELWP Advisory List of Rare and Threatened Plants.
- Threatened under the Victorian *Flora and Fauna Guarantee Act 1988*.

- Endangered under the Federal legislation: *Environment Protection Biodiversity and Conservation Act 1999*.
- Critically Endangered IUCN.

Threatening Processes

Over the last hundred years, *C. hastata* has suffered from a variety of threats including:

- Habitat destruction.
- Invasion of *Acacia longifolia* into previously suitable habitat.
- Small population size and limited populations.
- Lack of natural recruitment at some sites.
- Inappropriate fire regimes.

Deciding to translocate

The National Recovery Plan (Todd 1999) for *C. hastata* identifies conservation translocation, and in particular creating new populations, as a recovery action. All five populations, particularly the three populations supporting only one or two individuals, are highly vulnerable to extinction. Creating additional self-sustaining populations will reduce the species vulnerability to demographic and environmental stochasticity, and decrease extinction risk.

This conservation translocation project broadly has two objectives:

- To increase the number of populations and individuals.
- To increase the knowledge of biology, ecology and management requirements.

This conservation project also provides a valuable opportunity to involve the community and raise public awareness regarding the conservation of *C. hastata* and threatened species recovery in general.

Aim of the translocation

The overall objective of the project is to create two new self-sustaining populations and reduce the species vulnerability to demographic and environmental stochasticity and decrease extinction risk. This project refines the strategies for *Caladenia* conservation translocations based on knowledge of the ecology and distribution of pollinators. The project contributes to key actions of the National Recovery Plan including:

- Developing site management practices.
- Measuring population responses against recovery actions.
- Investigating the biology and ecology of *Caladenia* species.
- Establishing *ex-situ* collections of threatened *Caladenia* taxa.
- Establishing new populations of threatened *Caladenia* taxa in the wild.

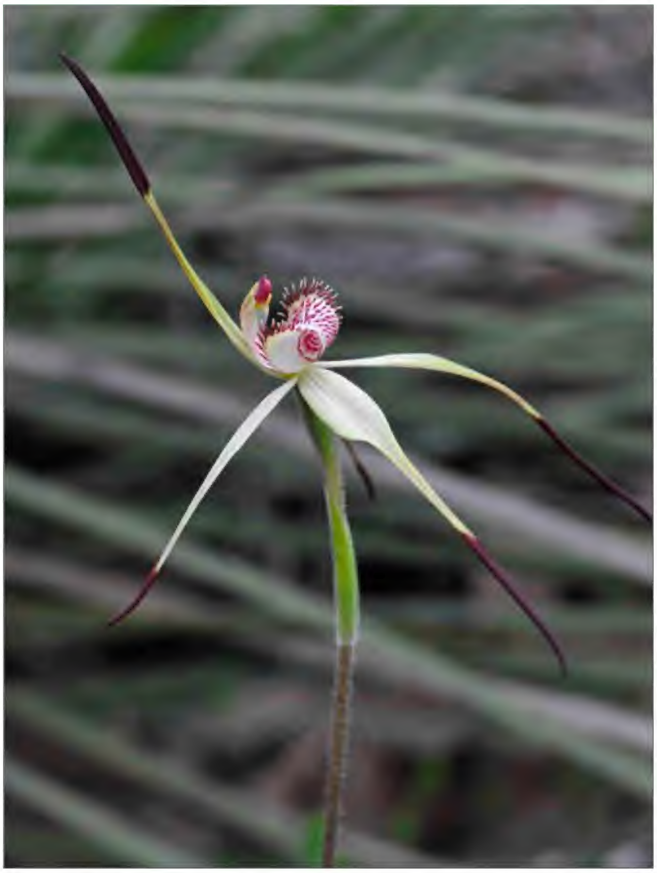

Figure 1. Flowering *Caladenia hastata* 12 months after conservation translocation: Photo: Noushka Reiter

Translocation working group and key stakeholders

The stakeholders involved in the translocation of *C. hastata* are: the Royal Botanic Gardens Victoria, the Victorian government Department of Environment Land Water and Planning (DELWP), Australian Network for Plant Conservation, Wimmera Catchment Management Authority, Portland Field Naturalists, Parks Victoria, Australasian Native Orchid Society (Vic Branch), and Portland Aluminium/Alcoa.

Biology and Ecology

Pollination

Caladenia hastata is a sexually deceptive orchid reliant upon a single wasp species *Lestricothynnus hastata* (Brown and Vlcek 2010) for pollination. In order to establish new populations the presence of the pollinator at potential translocation sites needs to be confirmed. Without the pollinator translocation populations will not be viable in the long term.

Mycorrhizal associations

Caladenia hastata, like most terrestrial orchids, is a mycoheterotroph (Rasmussen, 1995, 2002; Warcup 1971) and is dependent on a mycorrhizal association to complete its lifecycle. Mycorrhizal sampling of populations of *Caladenia hastata* have revealed orchids from both populations associate with undescribed *Serendipita* sp. (Reiter *et al.* unpublished data). Plants for conservation translocation were grown from seed with their mycorrhizae following methods of Reiter *et al.* (2016).

Site selection

The criteria for *C. hastata* conservation translocation sites were:

- Pollinator is found at the translocation sites.
- Reserved or permanently protected land managed for ecological purposes.
- Vegetation is a match with known sites of the species.
- Located within the natural range of the species.
- Low or no weed/invasive species present.
- Accessible for monitoring.
- Vegetation appears healthy and intact.
- Naturally occurring wild fires are still a possibility.
- Location is not impinged on by man-made infrastructure.
- The site is large enough to support a self-sustaining population.

Translocation proposal

A translocation proposal was developed with stakeholders and reviewed by the DELWP Translocation Evaluation Panel. The proposal was subsequently approved and permits for conservation translocation granted by DELWP and the land manager Parks Victoria.

Pre-translocation preparation, design, implementation and ongoing maintenance

Pre-translocation sites were assessed between 2008 and 2014 against the above selection criteria. A total of 233 sites were assessed for the presence of the pollinator species, *Lestricothynnus hastata* (Reiter *et al.* 2017). Pollinator presence was assessed using the standard baiting method for sexually deceptive orchids (Bower 1996). Of the 233 sites baited, the pollinator was only detected at five sites. Of the five sites with the pollinator present only two sites had similar vegetation structure and composition to existing wild extant populations (Reiter *et al.* 2017). These two sites were chosen as the conservation translocation recipient sites.

Subsequent actions

In total, 446 plants were planted across the two sites where the pollinator was present. Plantings were a group effort with all the key stakeholders and community involved between 2014 and 2016 (Figure 2).

Supplementation – ongoing monitoring

The conservation translocation populations are monitored on an annual basis, with data recorded on leaf emergence, flowering, pollination and recruitment. This data is used to describe the overall health of the population against the long-term criteria outlined in Reiter *et al.* (2016).

Site vegetation management

As *C. hastata* occurs in heathland sites, active management of translocation sites if fenced and caged is required to prevent biomass build up. For the two sites:

- Plants were caged and sites were fenced.
- Fences were erected with double gates allowing for opening of the gates and grazing over the summer months.
- Biomass build up is manually removed within cages while plants are establishing (long term cages are to be removed).

Outcomes

There was an average survival rate of 83% across the two sites. Flowering and seed set has been recorded at both sites and the conservation translocations are on track against long-term performance goals for each site.

What we learned

The pollinator for *C. hastata* is the main limiting factor for selecting sites for conservation translocation of this species. We have shown an essential step prior to translocation is ensuring the presence of the pollinator in any potential translocation site.

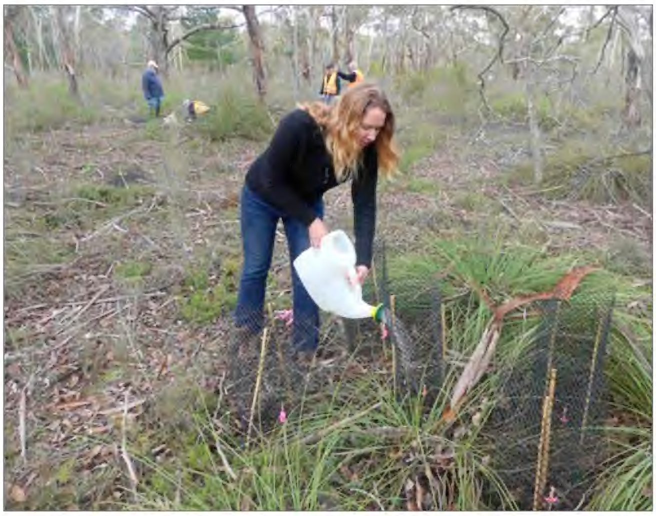

Figure 2. *Caladenia hastata*. Noushka Reiter watering plants after translocation. Photo: Gail Pollard

Acknowledgements

We would like to thank Kate Vlcek, Colin Bower, Gail Pollard and the Australasian Native Orchid Society, for contributing to pollinator surveys.

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Threatened plant translocation case study:

Ricinocarpos brevis, Euphorbiaceae

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The Species

- Non-lignotuberous, long-lived upright shrub.
- Endemic to Western Australia, classified Endangered (*WA Wildlife Conservation Act 1950*; *Environment Protection and Biodiversity Conservation Act 1999*).
- Three extant natural populations that occur over 100 km range to the north-east of Perth.

Threatening Processes

- Mining and exploration (direct removal, indirect effects).
- Weed invasion.
- Predation (foliage and seed).
- Inappropriate fire regimes.

Deciding to translocate

As part of an offset package to mine and subsequently remove *R. brevis* individuals from banded ironstone habitat, Cliffs Asia Pacific Iron Ore (Cliffs) were required to undertake research with the aim of contributing a scientific understanding of the ecology and conservation of this threatened species.

Cliffs commenced field translocations (2010 and 2011) on natural and disturbed landforms (drilling areas) with limited success (Cliffs 2011, 2012). In 2013, a comprehensive research program commenced, undertaken in collaboration with Department of Biodiversity, Conservation and Attractions (Kings Park Science; formerly Botanic Gardens and Parks Authority) and The University of Western Australia.

Further translocation research on establishing *Ricinocarpos brevis* on waste rock landforms was undertaken to build upon the existing knowledge for this species and assist in establishing populations in disturbed mining areas. This served a specific Interim Recovery Plan action that identifies the opportunity for translocation as a conservation strategy (DEC 2011).

Aim of the translocation

The proposed translocation was to improve the understanding of methods to translocate *Ricinocarpos brevis* and assist in the establishment of new populations on waste rock landforms and/or other areas disturbed by mine-related activities. If deemed successful, further translocations could reduce the overall impact to the species and assist in preserving the number of known individuals in the wild. This is consistent with the intent of the *Ricinocarpus brevis* Recovery Plan (DEC 2011).

Translocation working group and key stakeholders

- Department of Biodiversity, Conservation and Attractions (Kings Park Science) – oversee the development and implementation of translocation (research program, translocation proposal, propagation of material, installation); ongoing monitoring of translocation sites; and reporting to Cliffs.
- Cliffs Asia Pacific Iron Ore – develop translocation proposal; support implementation and ongoing monitoring of translocation; maintenance of translocation sites; and reporting to the (then) Department of Parks and Wildlife and relevant stakeholders.
- The University of Western Australia (School of Biological Sciences) – develop the experimental approach, analyse the data and report research findings.
- Department of Biodiversity, Conservation and Attractions (formerly Department of Parks and Wildlife) – advice on development and approval of translocation proposal.

Biology and Ecology

- Insect pollinated and monoecious.
- Long-lived (>100 years).
- Myrmecochorous (ant) and gravity seed dispersal.
- Physiologically dormant seeds.
- Application of germination stimulants (gibberellic acid, smoke water, karrikinolide) promote germination (Turner *et al.* 2018).
- Occurs on rocky outcrops and ridges associated with ironstone or basalt, in shallow or deep soils.
- Soil moisture is the primary driver of seedling emergence (Turner *et al.* 2018).

Site selection

Recipient sites (disturbed) for experimental translocations were selected based on:

- Being close to natural populations.
- Land tenure and risk of future mining activity.
- Safe and ongoing accessibility to sites.
- Landscape aspect.
- Rehabilitation stage of waste rock landform.
- Physical and chemical assessment of soils.
- Capacity to install infrastructure (e.g., irrigation).

Translocation proposal

A translocation proposal was developed by Cliffs in consultation with Kings Park Science to guide and provide justification for the translocation and the overall scientific approach. The proposal was submitted to (then) Department of Parks and Wildlife where it was independently reviewed. The proposal met the policy requirements on experimental plant translocations and was subsequently granted approval to proceed. Translocation approval conditions included submission of an annual report as well as additional proposals outlining any future translocation work.

Pre-translocation preparation, design, implementation and ongoing maintenance

Waste rock landforms were prepared to a mining standard that requires landform stability (i.e., erosion control) and a restoration standard that includes ripping to alleviate compaction, application of topsoil and surface sown seeds of local native species.

Provenance of material for translocation was determined by the species population genetic structure (Krauss *et al.* 2011) and material was collected under strict conditions. Material for translocation could only be sourced from the nearest natural population. To protect the sustainability of the natural population, limited material was collected from each plant for a proportion of the population.

Experimental translocations were designed to compare the success of tubestock planting and direct seeding. Tubestock experiments used 24 plants per treatment and tested up to five treatments in each translocation year. Treatments investigated to determine tubestock survival included shading, fertiliser, irrigation, propagation source (seed or cuttings), plant age, water holding crystals and biodegradable pots. Direct seeding experiments, used eight replicates of 25 seed for each treatment and tested up to six treatments each year. Treatments that were investigated included aspect (north or south-facing), shade, irrigation, seed burial, seed enhancement (priming or pelleting) and water holding crystals. Each replicate (tubestock or seed) was individually fenced to protect against herbivory (Figure 1).

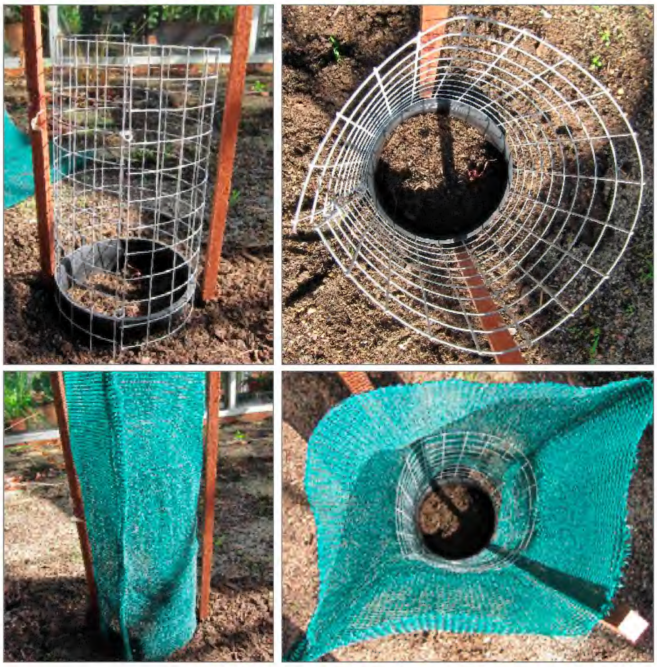

Figure 1. Plant guard mock up used for the *R. brevis in situ* experimental seeding trial. Top left: wire guard + wooden stakes; Bottom left: wire guard + shadecloth + wooden stakes; Top right: wire guard + wooden stakes – top view and; Bottom right: wire guard + shadecloth + wooden stakes – top view. Photo: Shane Turner

Experimental translocations were implemented yearly from 2013–2017 on two waste rock landforms. An automated, gravity fed irrigation system was maintained for one year (typically on one half of the experiment) to ensure one summer of supplemental watering for each year's translocation program. Cliffs maintained the irrigation system, and controlled weeds and pests on all sites to ensure the best possible outcome.

Monitoring and evaluation

Intensive monitoring of tubestock and direct seeding was conducted regularly after installation – at 1–2 months (late autumn); 4–5 months (spring); 7–8 months (early summer); 9–10 months (late summer) and 12 months (early autumn) for every year of the translocation program. Monitoring involved quantification of seedling emergence, survival, growth, health, and reproduction.

Evaluation showed that shading, irrigation and older tubestock increased seedling emergence, survival, plant health and growth. However, the magnitude of these increases depended on seasonal rainfall, as these approaches were more effective in better rainfall years. For example, overall seedling emergence (autumn to spring) for 2015 was lower (1.7%) than 2016 (4.5%), despite experimental irrigation, and was most likely affected by reduced rainfall over this period (2015 was 54% below average and 2016 was 13% below average).

Translocated plants have been observed to produce flowers (male and female), and insects have been observed visiting flowers.

Subsequent actions

This research will be incorporated into a restoration manual that outlines the best approaches, monitoring procedures and key targets for the future translocation and restoration of *R. brevis* to offset losses due to mine-related activities (Elliott *et al.* 2018).

Outcomes

Ricinocarpos brevis has a viable conservation strategy developed and optimised for the ongoing protection and management of the species, in the form of translocations on waste rock landforms.

What we learned

- Knowledge of population genetic structure is important for making informed decisions on sourcing material.
- It is possible to establish *R. brevis* on waste rock landforms from tubestock and seed.
- Soil moisture is the primary driver of seedling emergence, establishment and plant survival.
- Shading and irrigation improved establishment, growth and survival of tubestock and seedlings.
- Older tubestock (8–18 months) establish better than younger tubestock (<6 months) due to reduced impact on root systems during planting.

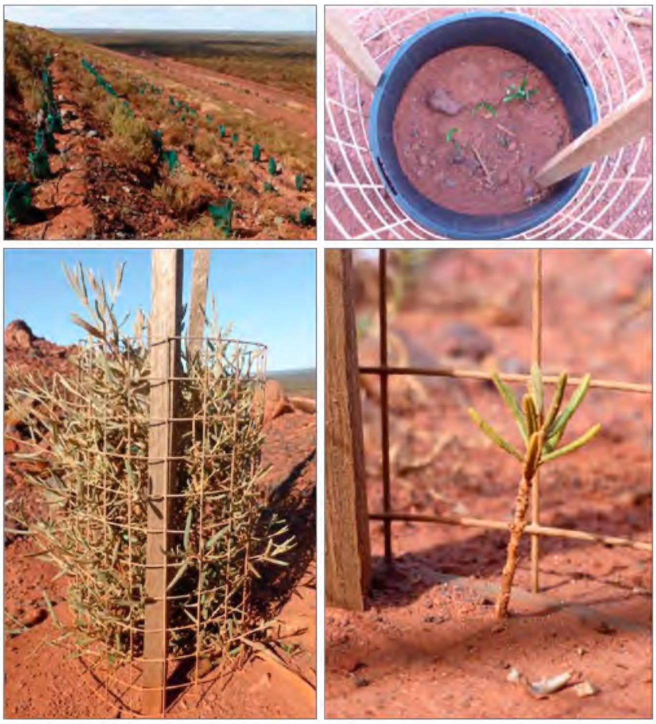

Figure 2. *Ricinocarpos brevis* translocation images. Top left: Translocation set up on waste rock landform, with gravity-fed irrigation (2017 translocation); Bottom left: Seventeen month old greenstock plant (2015 translocation); Top right: Newly emerged seedlings (~2-3 months old) *in situ* (2016 translocation); Bottom right: Two year old seedling that emerged *in situ* (2015 translocation). Photo: Carole Elliott

- Greater survival of tubestock derived from seed rather than cuttings.
- Investment in research provides critical information for successful plant establishment and an experimental framework that identifies and refines the best approach for future translocations.

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Threatened plant translocation case study:

Prostanthera eurybioides (Monarto Mintbush), Lamiaceae

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The Species

- Small, erect, aromatic, perennial shrub with violet flowers during spring (Figure 1).
- Endemic to South Australia.
- Two disjunct populations at Monarto (near Murray Bridge) and Mount Monster Conservation Park (near Keith).

Threatening Processes

- Habitat loss and fragmentation through agricultural development and quarrying.
- Weed competition.
- Herbivore grazing.
- Lack of natural recruitment, particularly at Monarto.

Deciding to translocate

Approximately 1200 wild plants were estimated to occur in the Monarto and Mount Monster populations in 2010 (Pound *et al.* 2010). The species is listed as Endangered under the Australian Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, and Critically Endangered under IUCN criteria.

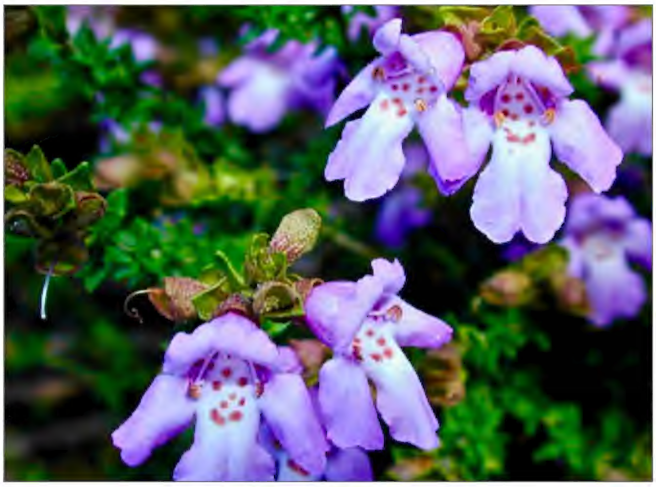

Figure 1. *Prostanthera eurybioides* in flower. Photo: M Jusaitis

Translocation trials were conducted at both population centers with the aim of enhancing natural populations while at the same time testing various techniques and management options (Jusaitis 2010). This case study focusses on a trial originally designed to examine the influence of herbivory on translocant establishment, but long-term monitoring additionally revealed an intriguing interaction of climate with herbivory (Jusaitis 2012).

Aim of the translocation

The aim of this translocation was to examine the influence of herbivores on growth and survival of transplants.

Translocation working group and key stakeholders

- Conservation Biology Unit, Botanic Gardens of South Australia – to plan and implement the translocation and perform ongoing monitoring and maintenance of the translocation site.
- Friends of the Upper South-East Parks – to assist with site selection and trial set up.
- *Prostanthera eurybioides* Recovery Team – to oversee planning and implementation of the translocation.

Biology and Ecology

- Seeds have physiological dormancy.
- The mericarp plug acts as a mechanical barrier preventing germination (Ainsley *et al.* 2008).
- Hot, dry summers can trigger loosening of the mericarp plug to enable germination.
- Plants are killed by fire, but fire stimulates recruitment (Jusaitis, unpubl. data).

Site selection

Plants grow on shallow, sandy loams associated with outcrops of granite or schist. A site with similar edaphic characteristics was selected within the existing population of *P. eurybioides* at Mount Monster Conservation Park.

Translocation proposal

The design for this experiment was submitted to and approved by the *Prostanthera eurybioides* Recovery Team.

Pre-translocation preparation, design, implementation and ongoing maintenance

Seeds collected from plants at the Mount Monster population were germinated and raised in our nursery. Twelve-month old seedlings were transplanted from tubes into replicated, paired, fenced and unfenced plots. Fenced plots (3 x 3 m) were enclosed by a chicken-wire fence to exclude rabbits and kangaroos. Planting layout and locations were accurately mapped, and no ongoing maintenance was necessary.

Monitoring and evaluation

We monitored plant survival, growth (height, width) and seedling recruitment over 17 years (1995–2011). Frequent grazing damage was observed on unfenced plants over this time, although this rarely proved fatal once plants were established, as grazed plants were able to regenerate with a new flush of growth when grazing was relaxed (Figure 2). By year 7, survival had stabilized at 96% (fenced) and 67% (unfenced), remaining at those levels for the next 4 years. In year 11 (2006), the translocation site experienced its lowest rainfall on record, followed by 2 years of below average rainfall. This severe drought resulted in a dramatic loss of fenced plants, while having no effect at all on the survival of unfenced plants (Figure 3 and 4). In the early stages of drought stress, fenced plants experienced dieback of stems, followed by shoot regeneration after seasonally favourable conditions (Figure 5). However, prolonged drought reversed this recovery and resulted in the death of many fenced plants.

The explanation for this unforeseen phenomenon lay in the size of unfenced plants which, due to frequent grazing, were about one third the size of fenced (ungrazed) plants (Figure 6). The larger size of the latter meant a far greater leaf surface area, higher transpirational losses and thus increased susceptibility to water stress, compared with the smaller, unfenced,

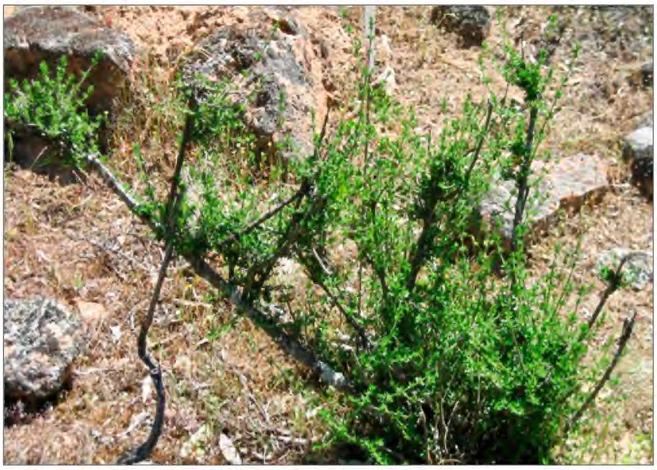

Figure 2. Regeneration of 13-year old transplant of *Prostanthera eurybioides* (unfenced) following repeated grazing. Photo: M. Jusaitis

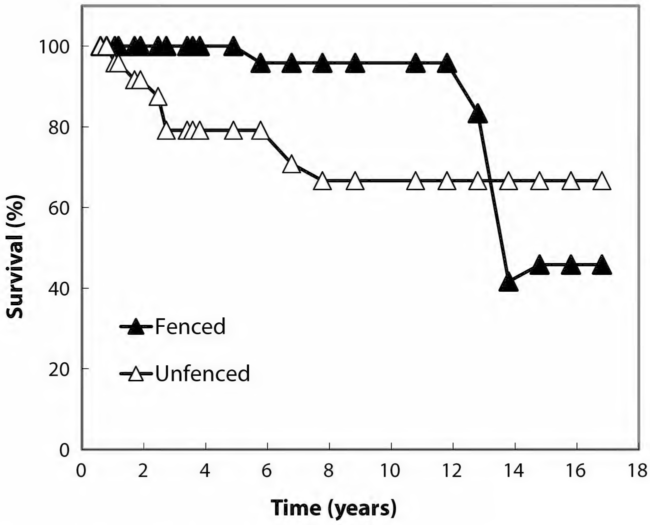

Figure 3. Survival of *Prostanthera eurybioides* translocants in fenced and unfenced plots over 17 years.

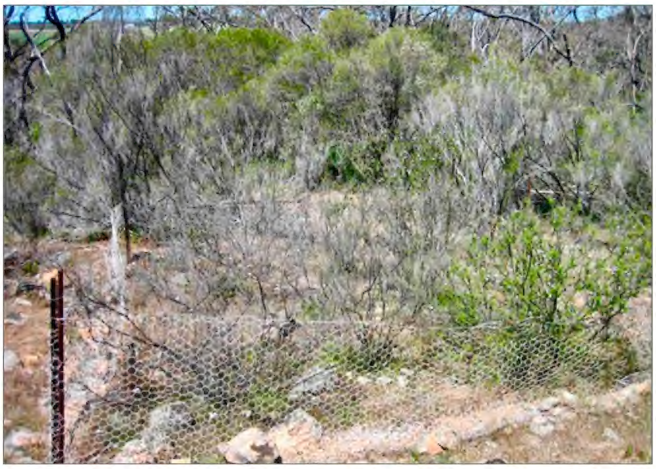

Figure 4. Fenced translocants of *Prostanthera eurybioides* showing dieback of 13-year old plants during a prolonged period of drought. Photo: M. Jusaitis

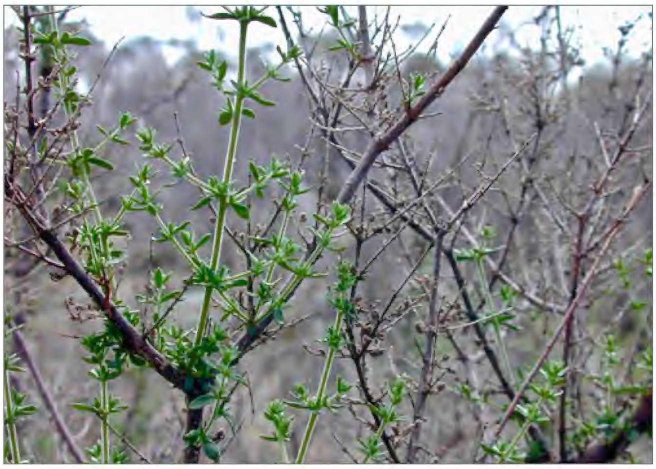

Figure 5. Regrowth of *Prostanthera eurybioides* shoots following earlier dieback of stems as a result of drought. Photo: M. Jusaitis

grazed plants which survived the drought (Veneklaas and Poot 2003, Virgona *et al.* 2006). Thus, although it was tempting to abandon monitoring after the population had been stable for 5 years, the next 5 years revealed an unexpected result which suggests that this plant is far more tolerant of grazing than was first thought. Indeed, grazing may assist these plants to withstand severe periods of drought. Interestingly, the first significant recruitment of new seedlings was observed following this drought (year 14), so the drought may also have played a role in overcoming seed dormancy (Ainsley *et al.* 2008).

Outcomes

This trial showed that *P. eurybioides* is indeed grazed by herbivores, resulting in lower growth and survival of translocants. However, long-term monitoring suggested that this may not necessarily be a bad thing, as the reduced leaf area of grazed plants assisted in their survival over an extended period of drought.

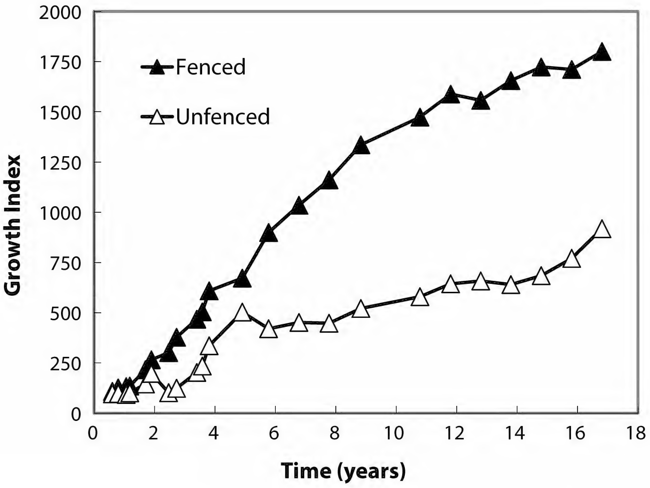

Figure 6. Growth of *Prostanthera eurybioides* translocants in fenced and unfenced plots over 17 years. Growth Index is the average of height, widest width and orthogonal width.

What we learned

- It is possible to establish new populations of this species.
- Protection from grazing, particularly during the early stages of plant establishment, encouraged vigorous growth, rapid flowering and seed production, and ultimately natural recruitment.
- Established plants were less susceptible to grazing damage once they reach their mature size.
- Grazed plants were less susceptible than ungrazed (fenced) plants to prolonged drought.

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Threatened plant translocation case study:

Persoonia pauciflora (North Rothbury Persoonia), Proteaceae

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The Species

- Spreading woody shrub growing up to 2 m high.
- Endemic to the Hunter Valley region of New South Wales.
- Around 1,000 individuals (including translocated plants) occur predominantly on private properties within an area of occupancy of 29 hectares and a linear range of 4.3 km.

Threatening Processes

- Habitat loss and fragmentation from urban development.
- Illegal clearing or harvesting.
- Accidental destruction from grazing or slashing.
- Fire.

Deciding to translocate

In 1999 *Persoonia pauciflora* (North Rothbury Persoonia) was formally described from a specimen collected from a floral survey in 1997. By 2012 the species' habitat was under threat from urban development and habitat fragmentation, and it was estimated that fewer than 350 mature individuals remained. Due to the ongoing threats and rarity of *P. pauciflora*, the species was listed as critically endangered under the NSW *Biodiversity Conservation Act 2016 (BC Act)* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. In response, a National Recovery Plan was drafted to guide on-ground conservation efforts. Despite the recent increase in the number of mature individuals to around 800 following additional surveys on private properties, the combination of a highly restricted distribution, threats and poor knowledge of the species' ecology, meant that the species would most likely decline without management intervention. The supplementation of existing populations as well as the establishment of new populations in secure locations were included as main objectives in the species' recovery plan. However, a full-scale translocation was thought at the time to be a high-risk conservation outcome. Consequently, a small-scale experimental planting trial in 2015 was considered as the most appropriate 'first-step' target objective, before subsequent large-scale translocations, for the successful recovery of the species. Research on the species ecology was undertaken concurrently to further inform the translocation program (Emery *et al.* 2016).

Aim of the translocation

The aim of the initial planting was to understand the factors involved in successful *P. pauciflora* translocation, and obtain the necessary knowledge required to implement a full-scale translocation project. The main factors considered were: propagation material used (seedlings versus vegetatively propagated), and fencing to exclude macropods. Subsequent plantings were informed by the results of this initial planting. An important aim of the translocation process was to involve the local community; initially involving a local landowner with plantings on her property, and later involving community members in plantings on National Park land.

Translocation working group and key stakeholders

- The Office of Environment and Heritage (OEH), Hunter Central Coast Branch, New South Wales – to oversee the development and implementation of the experimental translocation trial, and site selection and preparation prior to planting.
- Royal Botanic Gardens and Domain Trust, New South Wales (The Australian Botanic Garden Mount Annan, ABGMA) – collection and propagation of plant material (Figure 1), development of translocation plan, and site selection.

Biology and Ecology

- Self-compatible breeding system.
- Insect pollinated – native *Leioproctus* bees are the main floral visitors.
- Fruits are occasionally dispersed by birds.
- Seeds have mechanical (encased in a woody endocarp) and physiological dormancy.
- Germination is most likely to occur in spring and autumn.

Figure 1. An example of *Persoonia pauciflora* plants propagated for translocation at the Australian Botanic Garden Mount Annan. Photo: Nathan Emery

Site selection

Site selection was restricted to within the current distribution of *P. pauciflora* and, more specifically, in areas recently set aside as conservation offset land. Visits were made to these areas to determine whether the local vegetation was suitable Broad-leaf Ironbark (*Eucalyptus fibrosa*) and Spotted Gum (*Corymbia maculata*) habitat similar to where extant *P. pauciflora* plants occur. The physical and chemical soil properties were described, no pathogens were detected (soil samples were tested for *Phytophthora* spp. at the Royal Botanic Garden's Plant Clinic), and potential future threats (e.g., herbivory) were documented.

Three sites were chosen in conservation offset land situated near the centre of the distribution of *P. pauciflora* where several isolated extant plants were present. A fourth site was chosen in a second conservation offset block within the distribution a year later in 2016, and a fifth site in a third conservation offset block outside of the distribution was selected in 2017.

Translocation proposal

A translocation proposal was prepared using a template developed by ABGMA. The template was designed to provide background information, address licensing questions and direct the translocation design and implementation following the Australian Translocation Guidelines (Vallee *et al.* 2004). The proposal was then forwarded to the Office of Environment and Heritage (OEH) for assessment and feedback prior to the commencement of planting.

Pre-translocation preparation, design, implementation and ongoing maintenance

A schematic of the initial planting design is illustrated in Figure 2. At each of the three sites, twenty-four plants (evenly split by propagation type: seedlings and cuttings) were randomly planted in six blocks over an area of 10 × 16 m (a total of 72 plants). Each block contained two cutting-propagated plants and two seed-propagated, and three randomly assigned blocks were fenced off to exclude macropod predation. Cuttings were originally sourced from two populations of 3 and 17 adult plants, respectively, and propagated at the Australian Botanic Garden Mount Annan. Each block was 4 m^2 with plants placed 1 m from the edges to avoid contact with the fence and/or adjacent conspecifics. Several juvenile plant deaths from frost damage prompted us to protect younger plants with tree guards.

Refinements to the experimental design were subsequently made for the 2016 and 2017 plantings. In 2016, the recipient site was approximately 30 x 40 m, and divided into twelve 10 m^2 plots. Ten different vegetatively propagated *P. pauciflora* plant accessions were placed randomly within each plot (120 plants in total). Tree guards were placed around each plant to protect from frost damage for two years post-planting. The site was left unfenced as grazing pressures were thought to be low. The recipient site for the 2017 planting was approximately 50 × 40 m comprising twenty 10 m^2 plots. Ten different plant accessions were randomly spaced apart and then planted (200 plants in total). Each plant was protected for the first two years by a tree guard, and the site was fenced to protect from macropod grazing.

Monitoring and evaluation

We monitored plant health (including signs of physical damage, foliage loss and changes in foliage colour), survival, growth (plant height and width), flowering and fruiting. The monitoring schedule was initially intensive, weekly for the first month (to detect signs of translocation shock), fortnightly, monthly, quarterly and eventually half-yearly. By 2018 (30 months post-planting), survivorship among the initial three planting sites was 67–71%. Plant mortality predominantly occurred in the first five months post-planting due to either frost

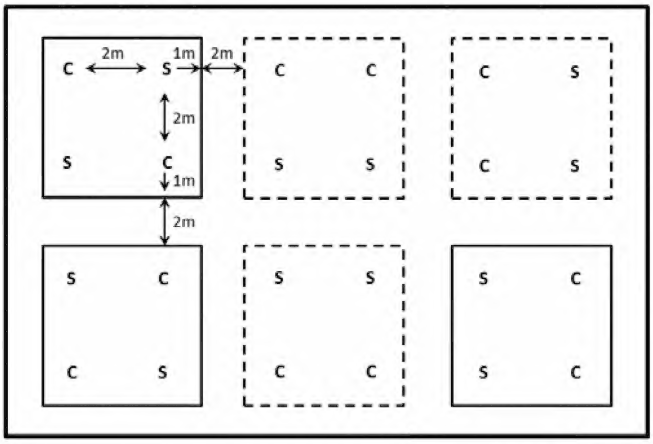

Figure 2. Site design of the initial translocation (plant and block positions were randomised at each site). Dotted line indicates an unfenced block, solid line represents fenced. C: plant cultivated from vegetative cutting; and, S: plant cultivated from seed.

or macropod damage and subsequent defoliation. All reproductively mature plants had flowered and set fruit for at least one season.

Monitoring plants in the initial translocation enabled the evaluation of fencing with propagation method. Survival was slightly higher for fenced plants (72%) compared to unfenced plants (63%), and plants propagated from cuttings (81%) compared to seedlings (58%). By 2018, unfenced plants had a higher growth index (measured as plant height and width) than fenced plants. Fenced *P. pauciflora* plants were often out-competed by other plant species that benefitted from the lack of grazing pressures within the plots.

Subsequent actions

The staged translocation approach for *P. pauciflora*, has resulted in increasingly successful plantings. The short-term success in the initial translocation gave us confidence to proceed with additional, larger translocations. The second translocation in 2016 was in a nearby conservation offset within the species distribution, and used 120 vegetatively propagated plants, which were protected with tree guards and left unfenced. By 2018, plant survival was 71% (86 plants) with 57% of plants having flowered. However, in this planting, mortality was associated with significant macropod grazing pressure.

Informed by the first two plantings, a new site was selected in 2017 in a conservation offset around 1.5 km linear distance from the nearest extant population. The site was fenced and had very little understorey, to lessen the effect of initial plant competition. After six months, 200 of the 203 translocants survived and 98% had flowered.

A new site will be chosen in 2018 for an additional translocation of 400–500 plants. Genetic testing on a representative sample of plants from the distribution will guide the design of this proposed translocation. Monitoring is ongoing across all sites to determine success and includes pollinator observations and recruitment events. The results of this research will be used to assist future translocation projects, such as those under the OEH New South Wales 'Saving our Species' program.

Outcomes

The long-term outcome of successful translocations is to establish self-sustaining populations. Although the monitoring data showed good short-term survival, growth, flowering and fruiting, no recruitment has yet been recorded. This was expected as previous literature suggest between 1–2 years for *Persoonia* endocarps to sufficiently breakdown for germination to occur (Norman and Koch 2008; Chia *et al.* 2016). A seed burial experiment of *P. pauciflora* showed no germination following 18 months burial (unpublished).

It was demonstrated that experimental trials are important for identifying several factors that might affect the establishment of *P. pauciflora*, thereby minimising any possible negative impacts of these for subsequent large-scale plantings. The original aim to establish an

Figure 3. Volunteers from the North Rothbury community being briefed by the translocation team as part of the *Persoonia pauciflora* planting day in 2016. Photo: Catherine Offord

experimental translocation trial demonstrated that plants propagated from cuttings had the highest survival. Furthermore, protecting plants from frost and macropod grazing increased survival in the short-term.

Over 100 volunteers from the local community assisted in the translocation plantings of *P. pauciflora* in 2016 and 2017 (Figure 3). Feedback gathered across three community planting days was resoundingly positive, and a translocation team member continues to provide information on *P. pauciflora* for the community.

What we learned

- A small translocation trial using an experimental framework was important in understanding factors important for establishment and survival.
- Attention to appropriate planting material is required.
- Fencing provides protection from macropod grazing, but can inhibit growth due to an increase in plant competition.
- Involving the local community in plantings encourages stewardship and respect for the plight of threatened species.

Acknowledgements

We thank: Future Harvest Revegetation Services and Ashley Deveridge from NSW National Parks and Wildlife Service for their assistance in planting; the local community of North Rothbury who attended community planting days, and in particular Monica Oppen for permitting and assisting with planting on her property. This translocation project was funded through the Office of Environment and Heritage and was an integral part of the conservation research program for this species.

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Threatened plant translocation case study:

Cassinia rugata (Wrinkled Dollybush), Asteraceae

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The Species

Cassinia rugata (Wrinkled Dollybush) was rediscovered in Tasmania in 2010, and is known from two private properties in the central north: (1) Rubicon that is covenanted with about 6 to 9 ha of suitable habitat, and (2) on Squeaking Point Road that has an informal area set aside of approximately 0.6 ha. A few plants were mapped on roadsides in 2010 in the neighbourhood of these properties. The total population in Tasmania in 2014 was approximately 500 mature plants. It is listed as Endangered in Tasmania and Vulnerable nationally, with only a few small populations known in Victoria (Carter and Walsh 2006).

Biology and Ecology

In central north Tasmania, *C. rugata* is a multi-branched shrub that grows to about 1.5 m in wet (sedgy) heathland. Plants decline rapidly when shaded by shrubs or trees, and plants in long-undisturbed open situations tend to become straggly and die back. Experiments at Rubicon showed that after fire, caged plants survived and grew faster than uncaged plants. However, response to fire is not predictable or well-understood.

Threatening Processes

All known roadside plants neighbouring the two extant Tasmanian populations have disappeared for reasons unknown within the last five years. The Squeaking Point Road population was threatened recently by conversion of its wet heathland habitat to a horse paddock; only a last-minute intervention with a willing land-owner prevented the extirpation of this population. Any other currently unknown populations are subject to similar risks, especially if not within view of a public road and a knowledgeable public.

Disturbance by slashing or burning to reduce competition seem essential to the survival of the species in Tasmania. Only one population has a management plan that requires this treatment.

Deciding to translocate

At Rubicon, we have prioritised *C. rugata* for active and experimental management. Gaps in our knowledge are reflected in the inconsistent response following the 2013 burn, where some groups of plants have largely vanished, while elsewhere seedlings appear to be thriving. Given our very limited knowledge about population dynamics, we decided that it would be prudent to experiment with translocation, which could provide a fall-back method should more groups of plants be seen to decline.

Aim of the translocation

The aim of the translocation was to learn more about possible methods for successful translocation, and to establish a new small self-sustaining population at Rubicon.

Translocation working group and key stakeholders

The landowners, Phil Collier and Robin Garnett, initiated the translocation experiments. Dr Wendy Potts, then Senior Botanist, Threatened Species Section, Department of Primary Industries, Parks, Water and Environment (DPIPWE), reviewed our proposed method and issued permit TFL14098 that permits the 'taking' of *C. rugata* plant material.

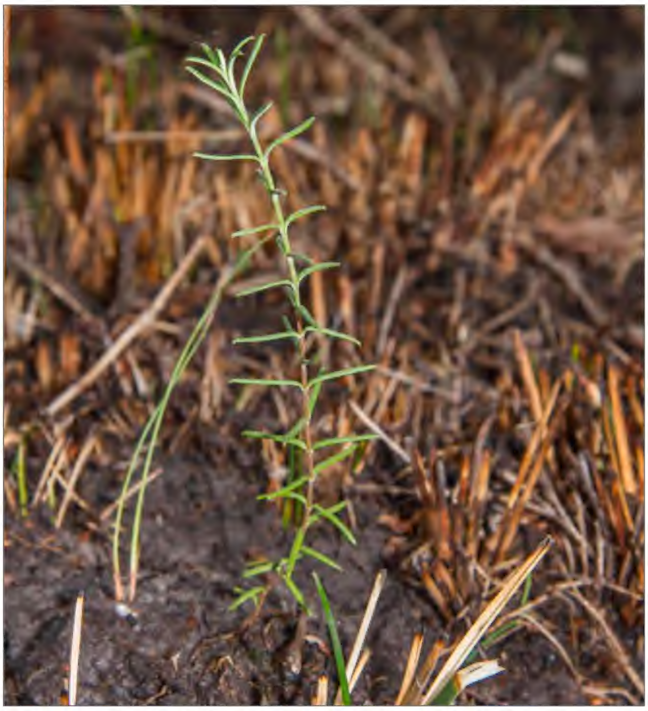

Figure 1. Translocated *Cassinia rugata* seedling at site 2. Photo: Phil Collier

We had previously collected *C. rugata* seeds under permit for James Wood, Seedbank Manager, Royal Tasmanian Botanical Gardens. These seeds, once cleaned and sorted, passed the Seedbank viability test, which is 75% germination.

Site selection

A site was selected in sedgy heathland at Rubicon (covenanted private land) that was burnt in April 2014. The site was similar to habitat where *C. rugata* occurs naturally, particularly in terms of seasonal inundation. It was about 100 metres from a known population, and closer to an isolated plant previously recorded that has since disappeared. The site previously did not support *C. rugata* plants, nor other priority species at Rubicon.

Translocation proposal

A proposal for a *Cassinia rugata* translocation and germination trial was prepared and circulated in April 2014, in part to assist with gaining a permit from DPIWE.

Pre-translocation preparation, design, implementation and ongoing maintenance

Experimental design

At the selected site, plots were located 3 m apart along four transects that were also 3 m apart. The plots were offset by 1.5 m on adjacent transects. Each plot was assigned a number from 1 to 30. Plots were first randomly assigned to be one of the 10 plots for seed sowing or 20 plots for transplanting seedlings. Within these two groups, plots were randomly allocated to the caged or uncaged treatment.

Seed collection and sowing

Seeds were collected from as many adult *C. rugata* plants as possible in February 2014 and bulked. Ten batches of viable-looking seeds were mixed with about 25 mL of dried sand and spread across the plots. The remaining seeds and seed heads were spread over a nearby burnt area, and 6 additional post hoc seed plots were established where seed had germinated in this area. Three of these plots were caged and the other three uncaged.

Transplants of seedlings that had germinated in the field

Translocated plants were sourced from a site that was burnt in April 2013. These were one-year-old seedling plants that had germinated naturally. Seedlings were selected that were generally very close to adult plants or close to other seedlings. Each seedling was excavated using a bulb planter with a minimum diameter of 60 mm at the base. The tool was rotated and pushed into the ground to a depth of about 110 mm and the resulting peaty soil was gently eased out while still inside the tube. This produced a consistent and stable cylinder of soil that included each seedling plant, or sometimes more than one plant.

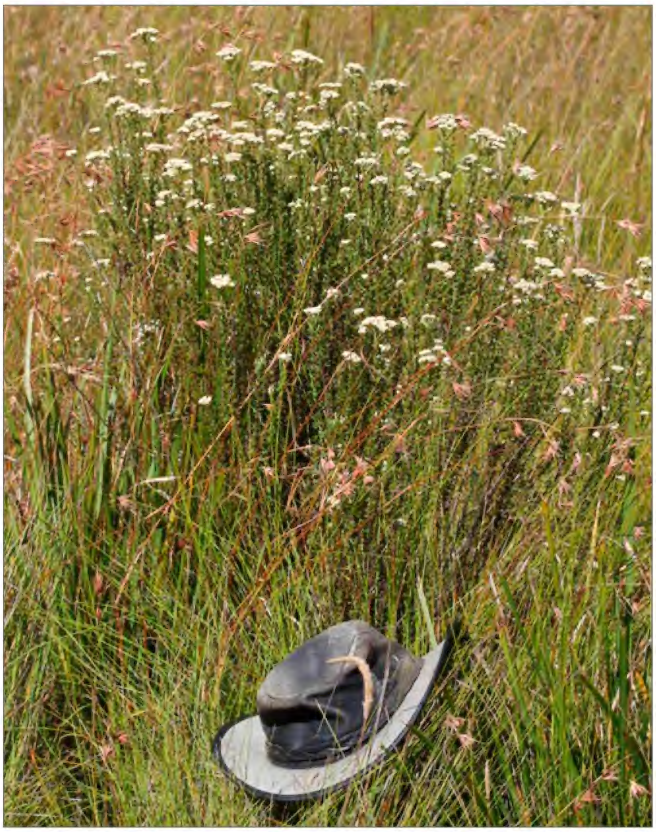

Figure 2. *Cassinia rugata* adult plant. Photo: Phil Collier

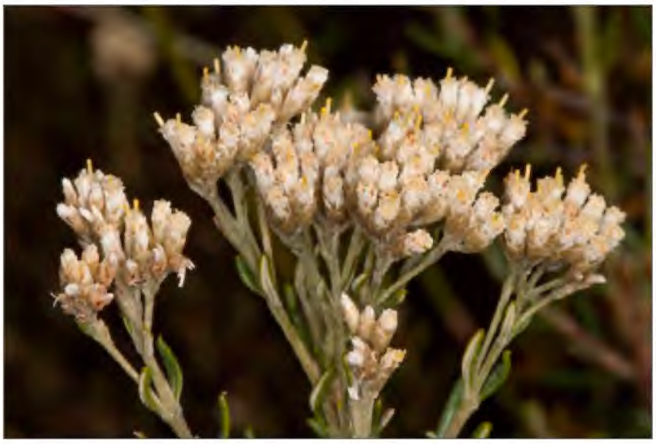

Figure 3. *Cassinia rugata* flower head. Photo: Phil Collier

Tagging plants and cage construction

Once the seeds were sown and plants translocated, a numbered flag was installed a measured distance from translocated plants and in the middle of each germination site. Cages were then installed at the allocated sites. Each cage was constructed from high-quality 60/4/1.4 netting i.e., 60 cm tall, 4 cm mesh spacing, 1.4mm wire. 1 m lengths of netting were cut ends joined to form a cylinder approximately 300 mm in diameter. Cages were secured to the ground with three galvanized metal stakes at the base and are robust enough to stand erect in this configuration.

Monitoring

After the translocation and seed sowing, the site was visited about every six months to check the cages and monitor the progress of the plants, including height and number of flower clusters. At each germination site, the number of seedling plants within 150 mm of its marker flag are counted. More recently, as the number of seedlings has declined, we have also measured the height of the tallest seedling at each site.

Outcomes

Results for translocated plants are based on analysis of monitoring data collected in January 2018 and, where required, a comparison with April 2014 data:

- 4 out of 14 uncaged plants are still alive compared with 10 out of 12 caged plants.
- Median height of living uncaged plants = 394 mm, median height of caged plants = 806 mm.
- In January 2018, none of the four living uncaged plants were flowering, while 5 of the 10 living caged plants were flowering. Two of the caged flowering plants were over 1000 mm tall and can reasonably be called mature plants.

For the germination experiment, we examined the number of surviving seedlings and the maximum height of the tallest living seedling at each plot. Combined results for plots where seeds were sown under experimental conditions and identified post hoc indicate no significant difference between caged and uncaged conditions. Very few of the seedlings are healthy and robust, and appear to be struggling to complete with surrounding vegetation.

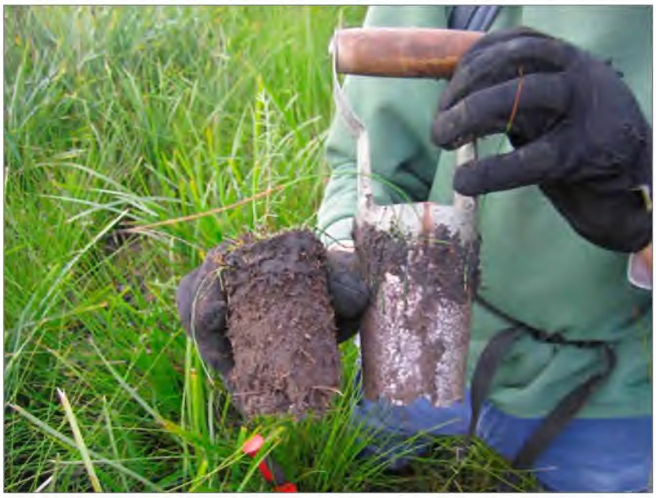

Figure 4. Excavated *Cassinia rugata* seedling to be transplanted and bulb planter. Photo: Robin Garnett

What we learned

Despite its limitation with sample size, the translocation experiment demonstrates that translocation is feasible, and that caging of plants provides reduced plant mortality, increased plant height and earlier flowering. This is because, immediately following the burn, the translocated plants were the dominant 'green pick' at the site and uncaged plants were grazed by macropods and/or rabbits, either setting them back or killing them.

In contrast, seeds sown at the same site did not benefit from caging. A likely reason for this is that these seedlings were tiny at the time surrounding vegetation was recovering from the burn. Unfortunately, the seedlings have remained relatively small compared to competing vegetation, and seem unlikely to survive to maturity, and/or the next scheduled burn.

Translocated plants in the experiment were one-year seedlings in an area that had just been burnt. As such they had a potential advantage over all other regenerating vegetation at the site. Comparison of the heights of plants in the translocation and germination experiments strongly indicates that any damage arising from the translocation process was much less significant than this one-year head-start in growth.

From a resource perspective, sourcing plants to translocate from a nearby burnt area is a major benefit. This also minimises any possible negative effects from introducing foreign soil or potting mix to the site. Caging of plants is resource-intensive from the perspective of materials, labour and maintenance. Translocating seedlings in the spring, when the surrounding vegetation is growing and potentially providing some protection, is worthy of a follow-up experiment, as this may reduce the need for caging. Lastly, the benefits of caging reflect the abundance of grazing animals near this location, which was not measured or controlled in the experiment.

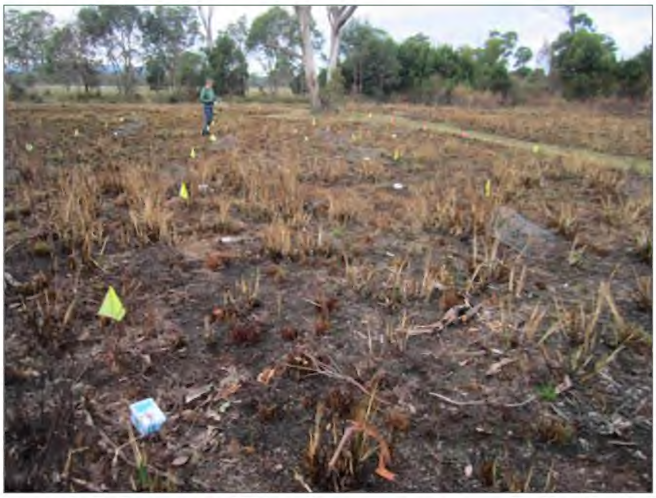

Figure 5. Site preparation, showing cages. Photo: Robin Garnett

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News from the Australian Seed Bank Partnership

DAMIAN WRIGLEY

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New Zealand Seed Conservation Techniques Training – December 2017

In early December 2017 the Australian Seed Bank Partnership (ASBP) sent two seed conservation experts to Auckland and Wellington, New Zealand to join Te Tira Whakamātaki (the Māori Biosecurity Network) and the Millennium Seed Bank Partnership (MSBP; RBG Kew) with delivery of Seed Conservation Techniques workshops to a range of stakeholders, including representatives of 11 hapū (sub-tribes), iwi (tribes) and Māori organisations. Jason Halford from the Brisbane Botanic Gardens, Mt Coot-tha in Queensland and Graeme Errington from Australian PlantBank at the Australian Botanic Garden, Mount Annan in New South Wales spent a week each sharing their knowledge of seed conservation techniques, as well as the identification of species susceptible to the impact of *Austropuccinia psidii*, more commonly known as Myrtle Rust.

For the first week, Jason winged his way to New Zealand for a week at the Auckland Botanic Gardens where he worked with Te Tira Whakamātaki's Waitangi Wood and the MSBP team: Ruth Bone, leader of the MSBP's Pacific programme, Bobbi Hope, training coordinator and Bev Maynard, an MSB seed collections manager. In the second week Graeme took Jason's place, heading to Wellington to support the teams with delivery of the training at Ōtari Native Botanic Garden and Wilton's Bush Reserve.

The two courses provided an overview of the theory behind seed banking as well as the practical considerations for identifying target species, coinciding field trips with seed availability, data management and the use of the MSB's seed bank kits. These are a fantastic resource to support creation of scalable, localized seed collections, with specialist collection, processing and drying equipment for those without access to seed bank infrastructure. The courses were also a great opportunity for the trainees to share their knowledge and experiences of seed collection and processing of New Zealand's flora among the groups and with visiting trainers.

The ASBP trainers were able to impart more than two decades of experience through the fortnight of training and came away with a great deal of learnings that will help us to deliver future seed conservation training. The experience will also improve our ability to engage with traditional owners both in Australia and overseas to improve conservation outcomes for native plants with both cultural and ecological significance.

Discussions on biosecurity provided a valuable insight into the management of the same biosecurity threat in different geographical, cultural and political realities. Myrtle Rust potentially impacts far fewer species in New Zealand than Australia yet these are no less ecologically, culturally or commercially important. When managing for biosecurity threats such as Myrtle Rust (and any future biosecurity threats to native plants) it's important that a concerted effort is made to coordinate effectively, from the planning of a response through to its implementation, including the engagement of traditional owners, land managers and other stakeholders.

Figure 1. First week of Seed Conservation Techniques course – Ōtari, Wellington, Aotearoa. Photo: Ruth Bone, MSBP

Figure 2. Second week of Seed Conservation Techniques course – Auckland Botanic Gardens. Photo: Ruth Bone, MSBP

The participation of the ASBP in this critical training would not have been possible without the generous funding from the Garfield Weston Foundation who support the MSBP's Global Tree Seed Bank Project, and the New Zealand Biological Heritage National Science Challenge support for Te Tira Whakamātaki. We would also like to thank our botanic gardens hosts and the New Zealand Ministry for Primary Industries for contributing to ASBP's participation. The ASBP would also like to extend a big thank you to the MSBP team and Te Tira Whakamātaki for coordinating this training and providing us with the opportunity to participate.

The ASBP is currently planning a training course for Crop Wild Relatives in Kakadu National Park in April where we will be using an Australian version of the MSBP seed bank kit. It's hoped that the training and drum kits will be used by Kakadu Rangers and traditional owners from Kakadu for many years to come in their efforts to conserve more of Australia's native species. We'll update you on how the course progresses in a future edition of APC.

Member profile

Heidi Zimmer

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What is your current position?

Senior Scientist (Threatened Species)

What projects are you working on at the moment?

Right now I am working on sorting out the listing status (i.e., Critically Endangered, Endangered, Vulnerable) for threatened plants endemic to NSW, especially where status in NSW is different to that at the national level. The logic behind this is: if you're Endangered in NSW, and endemic to NSW, then you should be listed as Endangered at the National level too. Assessments are done using the internationally accepted IUCN Red List Categories and Criteria, which focus on the species' geographic range size, population and declines in either of these. I really enjoy diving deep into the records of a species, finding out exactly who saw the species, where and when, and thinking hard about the species' ecology and what the most important threats might be.

I'm also involved with research into threatened plant translocation, forest restoration in northwestern Vietnam and advising on vegetation monitoring methods. When I get a spare moment, I try to keep up the work from my PhD on the ecology of the Wollemi Pine. And I'm the incoming editor for APC!

How did you end up working in plant conservation?

I grew up in East Gippsland, Victoria, going camping on the Snowy River, in the Alpine State Park, Errinundra National Park … so I've always loved being outdoors, in the bush. Dad always had a copy of Costermans* in the car for amateur botanising … one thing led to another, I did my PhD research on the Wollemi Pine, one of Australia's most iconic threatened plants, and now I work in the Science Division of the NSW Office of Environment and Heritage.

*The book "Native Trees and Shrubs of South-Eastern Australia" by Leon Costermans.

Bushwalking in the Blue Mountains. Photo: Michele Kohout.

What is your favourite plant and why?

I have to say the Wollemi Pine. Why? It's both beautiful and strange, it's a conifer but it looks like a fern, it's gnarly and multi-stemmed, never behaving like your typical straight-up-and-down botanical gardens exhibit. It's a rainforest tree, but we know it can survive and resprout after fire. It evolved during the time of the dinosaurs and it's held on until now. And the story of its chance discovery in 1994 has inspired botanists from across the world.

Why do you think the ANPC network is important and what do you see as our priorities?

The ANPC is a network for all: scientists, land managers, amateur and professional botanists, horticulturalists, ecological consultants … more than I can mention. Where other organisations focus on just one of these groups, ANPC is open to all, and thrives on this diversity of perspectives. I think the priority for ANPC is playing to its strength, which is being at the nexus between science and on-ground management – like it's currently doing with the development of the Guidelines for Threatened Plant Translocation in Australia third edition. And in bringing people together to share knowledge, the three-monthly issue of APC and the ANPC conferences are great ways to find out what others are doing in plant conservation through science, on-ground management, in horticulture, and make connections and learn something new.

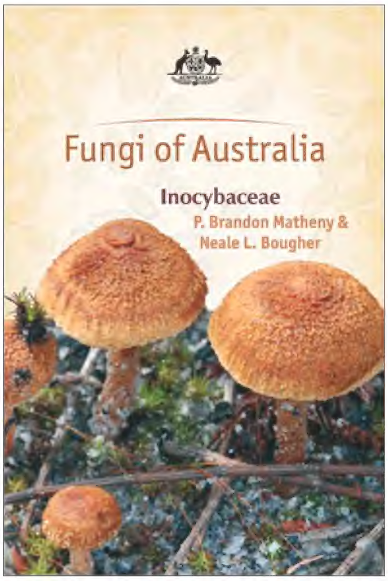
Book reviews

Fungi of Australia: Inocybaceae

P. Brandon Matheny & Neale L. Bougher. 2017.
ABRS, Canberra & CSIRO Publishing, Melbourne.
ISBN 9781486306664. RRP: $240.

This 582-page volume of the *Fungi of Australia* series covers the family Inocybaceae, comprising the genera *Inocybe*, *Auritella* and *Tubariomyces* (the latter reported for the first time from Australia). Nearly all included species are agarics (mushrooms) but, as in most Australia agaric families, there are several truffle-like species.

Inocybe and its relatives are quintessential 'little brown mushrooms'. *Inocybe* as a genus can often be recognised in the field by the small sporing-bodies with radially fibrillose pileus and finely toothed lamellae edges, but species delimitation and identification is challenging.



Brandon Matheny and Neale Bougher have produced a benchmark 21st century monographic treatment. Some 137 species are included, including a staggering 101 new species introduced as a consequence of the author's in-depth revision of the family in Australia. Some 90% of species are known so far only from Australia.

For each species, there is a comprehensive description of macro- and microscopic characters; accompanied by line drawings of microscopic characters and, for most species, colour photographs taken in the field. Keys are based on a combination of macro- and micro-morphology. A notable innovation is the inclusion of phylogenetic trees, based on several gene regions, covering most species, often with multiple collections of each. In addition, the introduction covers much of interest, including a history of the study of the family and a discussion of its biogeography.

Species are delimited by 'a combination of morphological, ecological and phylogenetic observations' and DNA sequence data have been extensively used for species delimitation. Consequently, there are many groups of closely related species, which appear almost indistinguishable on macro-characters, and where differentiation on micro-characters can be subtle.

I flicked through the volume looking for distinctive species as potential targets for Fungimap's mapping scheme. However, apart from *Inocybe violaceocaulis* (initially with violet stipe and pileus), I doubt that many species will be identifiable in the field, as even rare characters can be shared by close relatives. For example, the green tint to the stipe base in *Inocybe viridipes* also occurs in *I. cyanotricha*. Nevertheless, *Inocybe* and relatives vary considerably in spore and cystidia characters. Consequently, they provide an excellent subject of study for those who wish to extend their knowledge of fungi to the fascinating world of micro-characters, as introduced by the profusely-illustrated section on character variation in this work and exemplified by the spiny-spored *Inocybe acanthosperma*, *I. spiniformis* and *I. tertia*.

While the DNA sequences so essential to modern fungal taxonomy take species identification out of the realm of field mycology, the fact that so many of the species in this volume are linked to sequences will be of great practical value in identifying the environmental DNA sequences that are becoming the standard approach for detecting fungi in ecological studies.

All members of the family are considered to be ectomycorrhizal (ECM), forming mutually beneficial partnerships with plants. Ecological observations are summarised, such as preferences for certain vegetation types or tree hosts (which include not only eucalypts and southern beeches, but also, at least potentially, members of the Casuarinaceae, Fabaceae, Rhamnaceae and Phyllanthaceae). The sound taxonomy introduced in this volume will underpin further observations on host and habitat specificity and also investigations into the role of ECM fungi such as *Inocybe* in forest dynamics and in restoration.

Fungi of Australia: Inocybaceae is an exemplary taxonomic monograph and a welcome addition to the three previous taxonomic treatments in the *Fungi of Australia* series (Hygrophoraceae 2005; *Septoria* 2006; The Smut Fungi 2008). Given the vastness of the Australian mycota, and the fact that the previous volume in the series appeared a decade ago, the challenge is to increase the rate of production, while maintaining the standard set by this latest volume.

Tom May
Royal Botanic Gardens Victoria

Rocky outcrops in Australia – Ecology Conservation and Management

Damien Michael and David Lindenmayer
February 2018 | $ 49.95
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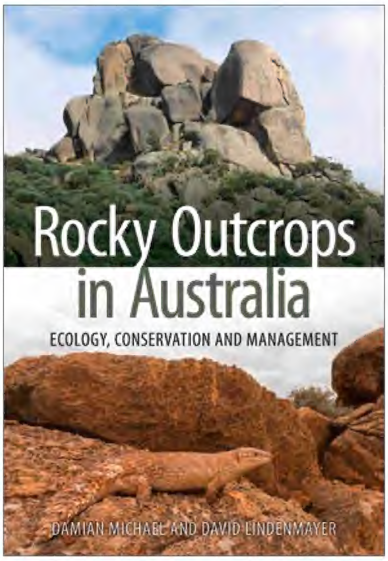

Rocky Outcrops in Australia
ECOLOGY, CONSERVATION AND MANAGEMENT
DAMIAN MICHAEL AND DAVID LINDENMAYER

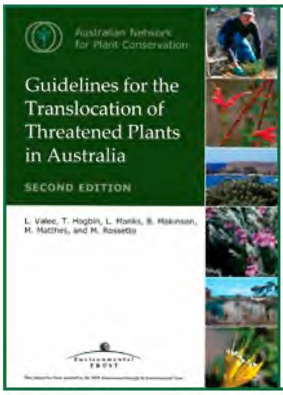
Rocky outcrops are an underappreciated ecological asset that occur throughout Australia, in national parks and farming landscapes alike. Visible exposures of bedrock, rocky outcrops range in size, shape and rock type, and occur in a wide range of vegetation types and climatic zones. Although they face many threats, rocky outcrops provide habitat and refuge for a wide range of flora and fauna, including many endemic and specialist species.

Damien Michael and David Lindenmayer's *Rocky outcrops in Australia* describes the ecological values of rocky outcrops, the species that occupy them, threatening processes and management. The book is written with non-specialist readers in mind, so the lack of technical language and jargon makes it a pleasure to read, whilst still being as comprehensive and informative as you might expect of a specialist text.

The book provides an overview of the ecological values of these landscapes for plant life, wildlife and threatened species and also touches on cultural and economic values. It describes the key groups of animals that inhabit rocky outcrops, and the final chapters provide a good overview of the key threats to these environments and clear guidelines for managing rocky outcrops for biodiversity conservation. The introductory chapter provides an interesting back to basics geology lesson on rock types and geological processes.

Plenty of relevant and well annotated photographs accompany the text. Although detailed species information is lacking for plants, the book would make a good accompaniment to local field guides when exploring rocky environments. Useful for scientists, naturalists and managers alike.

Katherine Selwood, University of Melbourne


Australian Network for Plant Conservation
Guidelines for the Translocation of Threatened Plants in Australia
SECOND EDITION
L. Vallee, T. Hogbin, L. Monks, B. Makinson, M. Matthes, and M. Rossetto
Environmental Trust

Guidelines for the Translocation of Threatened Plants in Australia

The deliberate transfer of plants or regenerative plant material from one place to another (e.g., re-introduction, introduction, re-stocking).

Second Edition 2004 | L. Vallee,T. Hogbin, L. Monks, B. Makinson, M. Matthes and M. Rossetto Australian Network for Plant Conservation, Canberra.

For more information and to order, go to http://www.anpc.asn.au/translocation

ANPC News

Cuttings: Plant news from around Australia

Six native species removed from threatened list

Western Australia's Environment Minister Stephen Dawson has approved the recommendations of the Threatened Species Scientific Committee to amend the list of threatened flora and fauna in Western Australia. Four species of flora, *Asterolasia nivea*, *Asterolasia* sp. Kalgan River, *Cryptandra congesta* and *Stylidium wilroyense*, were removed from the threatened flora list following a review of their conservation status against international criteria. Another species of flora, *Opercularia acolytantha*, was thought to be extinct until work by the Department of Biodiversity, Conservation and Attractions discovered that several specimens of the species had been incorrectly identified and it is now known to exist in a number of locations. Eight species of flora were added to the list of extant threatened flora species as a result of targeted survey work that demonstrated those species met the international criteria for threatened species. These species were *Acacia shapelleae*, *Bossiaea* sp. Frankland, *Eremophila glabra* subsp. Scaddan, *Hibbertia* sp. Toolbrunup, *Lasiopetalum* sp. Mount Caroline, *Lepidosperma bungalbin*, *Melaleuca* sp. Wanneroo and *Stylidium asymmetricum*. Another plant species, *Myriocephalus nudus*, is only known from the original specimen collected by James Drummond, the first Government Botanist in Western Australia, in the early 1840s. This species has been added to the list of presumed extinct flora.
https://www.dpaw.wa.gov.au/news/media-statements/minister-for-environment/item/3452-six-native-species-removed-from-threatened-list

Amendments to the federal Threatened Species List

The Minister for the Environment and Energy has approved the inclusion of 16 plant species and the removal of two plant species under the *Environmental Protection and Biodiversity Conservation Act (1999)*. The plants included on the list are *Caladenia luteola, Caladenia hopperiana, Commersonia apella, Grevillea thelemanniana, Austrostipa bronwenae, Austrostipa jacobsiana, Banksia vincentia, Diplolaena andrewsii, Eremophila glabra* subsp. *chlorella, Goodenia arthrotricha, Leucopogon nitidus, Leucopogon* sp. Ongerup (A.S. George 16682), *Marianthus paralius, Stylidium applanatum, Synaphea* sp. Pinjarra Plain (A.S. George 17182), *Synaphea* sp. Serpentine (G.R. Brand 103). The two plants removed from the list are *Marianthus mollis and Lepidium catapycnon.*
http://www.environment.gov.au/news/2018/02/15/amendments-threatened-species-list

Transport hub gets green light provided rare plant gets protection

Plans to convert a defence site into a freight hub in Sydney's south-west can proceed, provided developers implement strict conditions to protect a rare flowering plant, the Land and Environment Court has decided. The discovery of 370 individual *Hibbertia fumana* plants – a species last documented in 1823 and long thought extinct – threatened to stall development of the $1 billion-plus Moorebank Intermodal Terminal Facility.
https://www.smh.com.au/environment/conservation/transport-hub-green-light-rare-plant-protection-20180306-p4z34f.html

Endangered native plant species at Elderslie gets government funding

Almost a quarter of a million dollars has been injected into a regional conservation project to protect an endangered plant species at Elderslie. (NSW) State environment minister Gabrielle Upton visited Camden to announce $239,250 would be invested into a scheme to protect the *Banksia integrifolia* plants in the Banksia Scrub Forest. Camden MP Chris Patterson said he was pleased to see the much-needed funding allocated to the local flora. "The funding will be used to erect fencing, restrict the dumping of waste, weed control, revegetation, seed-banking, research into appropriate fire regimes, monitoring and community engagement," he said.
http://www.camdenadvertiser.com.au/story/5201817/endangered-native-plant-species-at-elderslie-gets-government-funding/?cs=1436

Happy Hibbertias – prescribed burn stimulates endangered species germination

An ecological burn was conducted in a Fleurieu swamp in South Australia last spring with the aim of regenerating a critically endangered plant. *Hibbertia tenuis* (Yundi Guinea-flower) was described as 'common' or as having 'many plants' at Yundi Swamp from surveys in 1980, 1985 and 1993. A 2007 survey identified only 10–20 mature plants, and no records in other past locations. Following the prescribed burn hundreds of *Hibbertia tenuis* seedlings have now been observed coming up in areas with newly exposed soil. Plants at this site were no longer reproducing due to a lack of disturbance and a lack of space, so the presence of fire has provided the conditions needed for the species to continue with its lifecycle.
http://dewnr.cmail20.com/t/ViewEmail/d/8370A3171B6A12E3/E830A086DF2C0EE5A29558A201773426

Exclusion: It's not always a bad thing!

An important part of DEWNR's environmental assessments undertaken before each prescribed burn is determining whether any areas should be left unburnt to protect endangered plants or animals. This may be a vital area of shelter for bandicoots, or a rare plant that does not respond well to fire. When a small population of critically endangered orchids was found to be within a planned prescribed burn area at a swamp in Cleland Conservation Park this spring an exclusion zone was set up to keep fire away from half of the population.
http://dewnr.createsend1.com/t/ViewEmail/d/8370A3171B6A12E3/E830A086DF2C0EE5A29558A201773426

Is burning key to wattle regeneration?

A small two hectare area of Ferries McDonald Conservation Park at Monarto (SA) was burnt last week during an ecological prescribed burn carried out by the Department of Environment Water and Natural Resources (DEWNR) to encourage the regeneration of a nationally vulnerable acacia. The plant being targeted, resin wattle (*Acacia rhetinocarpa*), is listed as vulnerable nationally, and is also a species endemic to South Australia, meaning it is found only is SA. Natural Resources SA Murray-Darling Basin (SAMDB) Restoration Ecologist Kylie Moritz said it might seem strange to burn a species that is vulnerable but the aim behind the small ecological prescribed burn was to see how the resin wattle would respond to a spring fire.
http://www.naturalresources.sa.gov.au/samurraydarlingbasin/news/171204-is-burning-key-to-wattle-regeneration-nws

Mount Canobolas to remain closed for weeks

The Mount Canobolas State Conservation Area will remain closed for at least the next few weeks as the NSW National Parks and Wildlife Service checks fire-damaged trees along roads, walking tracks and in picnic areas. Ranger Steve Woodhall said about 70 per cent of the conservation area was burnt out during last week's fire, or about 1160 hectares of the 1600-hectare total.
http://www.centralwesterndaily.com.au/story/5243033/safety-fears-prompt-further-mount-closures-after-bushfire/?cs=103

Editor's note: Mt Canobolas has two endemic threatened species: Eucalyptus canobolensis *and* Prostanthera gilesii*, and two threatened ecological communities, the Xanthoparmelia lichen community and Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland. I will be following the recovery of these species and ecological communities after the fire with great interest.*

Eucalypts: 10 things you may not know about an iconic Australian

You'd be hard pressed to go more than 10 minutes without spotting a eucalyptus tree in Australia. They dominate our landscapes from the bush to our backyards, paddocks, parks and pavements. They are extraordinary plants and many people love them. One of those people is botanist Pauline Ladiges. The world expert has been studying this iconic group of plants for the past 55 years. "The most interesting thing for me is the diversity of the whole eucalypt group and its extraordinarily ancient history," said Professor Ladiges from the University of Melbourne. So how much do you know about this iconic plant?
http://www.abc.net.au/news/science/2018-01-26/eucalyptus-trees-an-iconic-australian/9330782

Lost with the brigalow – Rediscovering something lost in order to save what still exists

The vast brigalow forest that extended from northern New South Wales to southern Queensland has been cleared in the space of 60 years. It seems likely that many species have become threatened with the destruction of the forest. Rod Fensham and co-workers have identified the plant species that are likely to have become threatened and many of these species were not previously recognised as imperilled.
http://www.nespthreatenedspecies.edu.au/news/lost-with-the-brigalow-rediscovering-something-lost-in-order-to-save-what-still-exists

Threatened Species in Urban Areas – Clean Air and Urban Landscapes Hub

When thinking of places that are great for conserving threatened species, the word 'urban' rarely springs to mind. Yet recent research shows that 30% of Australia's EPBC-listed threatened species occur in cities, and that urban areas support substantially more threatened species per unit area than rural areas. Better management of our urban spaces is critical for conservation of Australia's threatened species. Explore the map to see which threatened species have been recorded in or near 98 urban areas across Australia, as well as species that were once present but are no longer found there. Clicking on a species name will take you to more information about that species in the Atlas of Living Australia.
https://www.nespurban.edu.au/data/threatened-species/

Prioritising threat management for alpine peatlands

A new TSR Hub project led by Monash University is collaborating closely with Parks Victoria to improve the management of alpine peatlands in Victoria. Alpine peatlands are an endangered ecological community in Australia and provide critical habitat for a large number of threatened species including frogs, lizards and fish. Despite being located in some of Australia's most remote and pristine feeling national parks, the peatlands are subject to a wide variety of interacting threats including introduced animals, weeds, changed hydrology, climate change and increased fire frequency. Managing and recovering alpine peatlands is hampered by a lack of knowledge about how different alpine peatlands respond to different management interventions. This project will identify where and how to manage the different threats to alpine peatlands to aid recovery efforts. It will also identify critical gaps in our knowledge of alpine peatland ecology and recovery, which can direct future research and monitoring effort to where it is most needed.
http://www.nespthreatenedspecies.edu.au/projects/supporting-alpine-peatland-recovery-by-prioritizing-action-on-threats

NatureMaps and EnvMaps upgrade – SA Dept of Environment and Water, 28 March 2018

If you're researching a particular South Australian plant or animal species for a school or university assignment, or are just simply interested in SA flora and fauna, accessing species data from NatureMaps and EnvMaps has just got a lot easier. The new features allow you to make a simple species list and extract it to MS Excel, map a species on the screen, see the details of a single record on the screen and use filters to refine your searches.
https://data.environment.sa.gov.au/NatureMaps/Pages/default.aspx

Monitoring for threatened species and ecological communities

Monitoring is fundamental to good policy and effective conservation management. Data derived from monitoring underpin the process for listing of species as threatened, which is a precursor to recognition in policy. When monitoring programs are well designed, they provide critical information to diagnose causes of decline, identify priorities for additional research, evaluate management effectiveness and assess the urgency of management. Monitoring can also be a powerful tool for engaging the community. One of the first projects initiated by the TSR Hub was to gather monitoring experts, and managers who need and use monitoring information, from all over Australia to discuss the value of, and many challenges involved in, monitoring threatened biodiversity. The workshop led to an authoritative edited book *Monitoring Threatened Species and Ecological Communities*, released in January 2018.
http://www.nespthreatenedspecies.edu.au/news/monitoring-for-threatened-species-and-ecological-communities

Australia's ecosystems and ecological characteristics mapped

Ecosystem maps allow managers to craft strategies that ensure that our unique ecosystems and their services are not lost. Unfortunately, however, there is no consistent way of mapping ecosystems across nations and jurisdictions. Thankfully, this is set to change courtesy of TERN and the University of Adelaide who have remapped the characteristics of Australia's ecosystems using nationally and globally consistent methods. The new maps capture the three major factors driving ecosystem formation—macroclimate, lithology and landform—with multiple spatial indicators. Vegetation structure has also been mapped and combined with the three indicators of ecosystem formation to produce 'ecological facets'—distinctive and unique ecological units.
http://tern.org.au/Newsletter-2018-Mar-Aust-Ecosystem-Map-pg32460.html

Conferences and courses

Conference: Conservation in Action – Research to Reality – Bathurst, 15-17 May 2018

From scientists to policy makers, program managers through to specialists in implementing works in the field, this event will pull together all disciplines of natural resource management to demonstrate how we're turning Research into Reality. The conference program boasts a full two days of presentations from leaders in their respective fields, and a series of practical workshops. Sessions will pull together research findings through to case studies and will demonstrate all of the policies, programs and plans in between that enable environmental practitioners to implement best management practice on the ground.

http://www.cwcewa.com.au/conservation-in-action-2018

Plant Biosecurity CRC National Science Exchange 2018 – Melbourne, 29-31 May 2018

The National Science Exchange 2018 hosted by the Plant Biosecurity Cooperative Research Centre (PBCRC) will focus on biosecurity built on science for agriculture and the environment. The three day conference will include a variety of plenary sessions, presentations from research teams, and open discussions and networking on plant biosecurity issues encompassing biosecurity research, policies, operations and management.

http://www.pbcrc.com.au/science-exchange-2018

ACT Woodlands Forum 2018 – Canberra, 27-28 June 2018

The ACT Woodlands Forum will bring together, scientists, researchers, practitioners and community groups to share knowledge and learnings about woodlands and woodland species in the region. The forum will include invited speakers on a variety of topics and will also include speed talks and poster presentations, aimed at sharing knowledge from new researchers, community based science and outcomes from on-ground projects. This is a free event, however places are limited so registration is required.

https://www.eventbrite.com.au/e/act-woodlands-forum-2018-tickets-44623765885

Forum: Citizen Science – Challenges & Benefits for Biodiversity Conservation – Brisbane, 11 August 2018

The forum will explore a wide range of issues relating to the challenges and benefits of Citizen Science in biodiversity conservation. Presentations will be 15-20 minutes duration, with a panel Q&A session at the end of each thematic segment.

https://nrmjobs.com.au/noticeboard/2018/20000315/Forum_Citizen_Science_Challenges_Benefits_for_Biodiversity_Conservation

Black Mountain Symposium 2018 – Canberra, 24-25 August 2018

A one day symposium of natural and cultural environmental themed talks about what we know from 50 years experience of Black Mountain and how that knowledge might inform its use and security over the next 50 years. Including the diversity and ecology of plants, and fire ecology. Guided walks on Black Mountain will also be available. Registrations now open.

https://www.friendsofblackmountain.org.au/Symposium

21st Australasian Weeds Conference – Manly, Sydney, 9-12 September 2018

The Weed Society of New South Wales Inc., on behalf of the Council of Australasian Weed Societies Inc., will be hosting the 21st Australasian Weeds Conference in the popular Sydney beachside suburb of Manly. This biennial conference carries on a long tradition of bringing the weed management community together to discuss new developments and share information about cutting-edge and best weed management practices. Delegates will come together to network with peers, engage with industry sponsors, listen and participate in presentations and field trips on a variety of topics including: New technologies in weed management; Biological, mechanical, and chemical weed control and research; Herbicide resistance; Weeds of crops and pastures; Environmental weeds and Weeds of National Significance. Registrations now open.

http://www.21awc.org.au/

SER Australasia Conference 2018 – Brisbane, 25-28 September 2018

The Society for Ecological Restoration Australasia (SERA) is pleased to announce the 2018 conference 'Striving for Restoration Excellence' to be held at the University of Queensland, Brisbane. If you are a scientist, practitioner, manager, policy maker, planner or someone who cares about our bush, seas and waterways you do not want to miss this conference! If you are interested in restoration planning and management or want to ensure restoration really makes a difference then this is the conference not to be missed. The proposed themes for SERA 2018 are focused around four pillars: Principles & Practice – doing it right in restoration; Biomes – rainforests, woodlands, grasslands, seagrasses and beyond; Impact – making a change; Specialist Disciplines – seed technologies, provenance, marine restoration and more. Session Proposals are now open – sessions are 90-minutes with a 15-minute introduction, followed by five 15-minute presentations that form a cohesive theme.
https://www.sera2018.org/

Expressions of interests: Big Scrub Rainforest Pre-Conference Field Trip for SERA2018 – 22-23 September 2018, Lismore to Brisbane, or 19-26 September 2018, Sydney to Lismore

AABR is collaborating with the Society for Ecological Restoration Australasia (SERA) and Big Scrub Landcare (BSL) on a very special field trip to northern NSW to look at the progress being made in rainforest restoration in the 'Big Scrub' landscape near Lismore. This will be a major field trip where key participants in the program will be taking stock of progress to date and sharing their experience gained from decades of experience. Register your interest here
https://www.surveymonkey.com/r/BigScrub

Ecological Society of Australia 2018 Conference

ESA18 will be held at the Royal International Convention Centre (RICC) in Brisbane. Located at the interface between temperate and tropical Australia, the Brisbane region hosts an enormous range of habitats. More than 400 bird species have been observed in the Brisbane area, and conference trips will treat attendees to a smorgasbord of biodiversity as well as picture-postcard landscapes ranging from majestic rainforest to idyllic islands. There will be an opportunity to participate in early morning nature walks prior the start of the conference each day. Call for abstracts close 20 July 2018. Registration opens 7 May 2018. Early bird registration close 14 September 2018.
http://esa2018.org.au/

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Photo: *Spyridium furculentum* growing at the RBGV, Melbourne. (J. Lynch)

Research round up

COMPILED BY KIRSTIN COWLEY

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